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FEBRUARY

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EDGAR FRANKLIN WITTACK '35

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NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
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"Seven Skeletons Deep in the Earth"

Amazing Escape of Edward Eiskamp and his Six companions saved from death in Underground Maze

"MILE AFTER MILE we had wormed and twisted and crawled our way into the blackness of those caverns that burrow deep under the Catskills near Sam's Point," writes Edward Eiskamp.

"Down at last to the very bottom, we relaxed for that moment of exultation every explorer seeks. And in that moment, my flashlight slipped from my hand. There was a sickening splash, and darkness closed over us.

"My heart pounded in sudden panic. We were trapped in a vast underground labyrinth, blinded by inky blackness. Trapped where only light could save us.

Map shows location of Sam's Point Caverns where Eiskamp Party made Amazing Escape.

"Seven skeletons would grace this rocky vault Nature had prepared for us. What a grisly joke fate had played!

"But then we saw a glow of light from that deep, icy pool where the flashlight lay. We groped our way cautiously toward it . . . expecting every instant to see our beacon of hope fade and die.

"It didn't fade or die, or this story would never have been written. Fished up through eight feet of water, those fresh, strong Eveready Batteries maintained the brilliant beam that led us thankfully over the long, slow route to daylight.

"Until that day none of us realized how important fresh, dependable Evereadys can be. But we sure do now! For, if those batteries hadn't been fresh, if they had gone stale on some dealer's shelf they never could have brought us back from our near-grave."

Edward Eiskamp

Edward Eiskamp who, with six companions, had this thrilling experience in the Sam's Point caves in the wilds of the Catskills.

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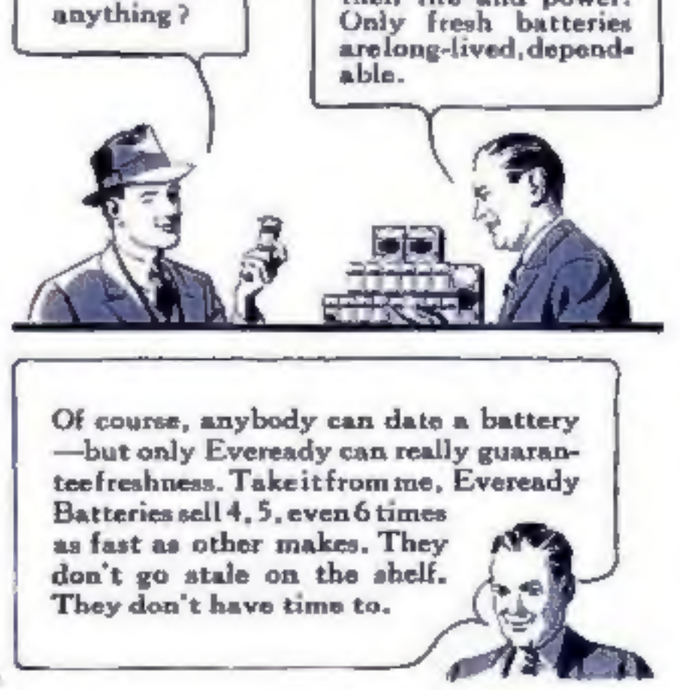

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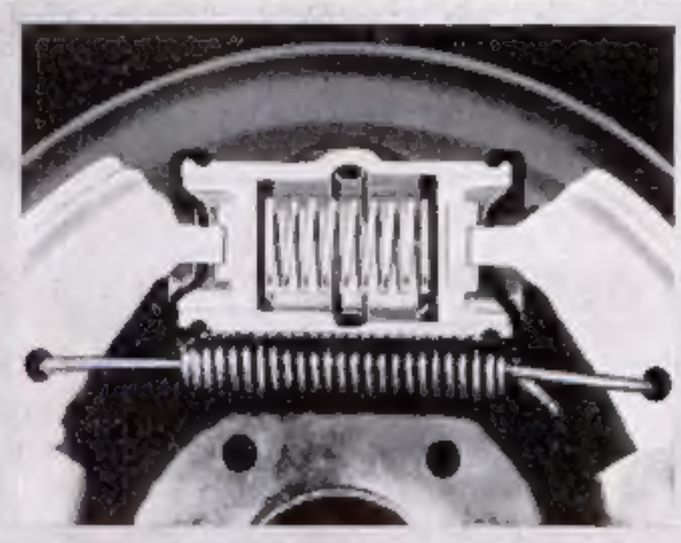

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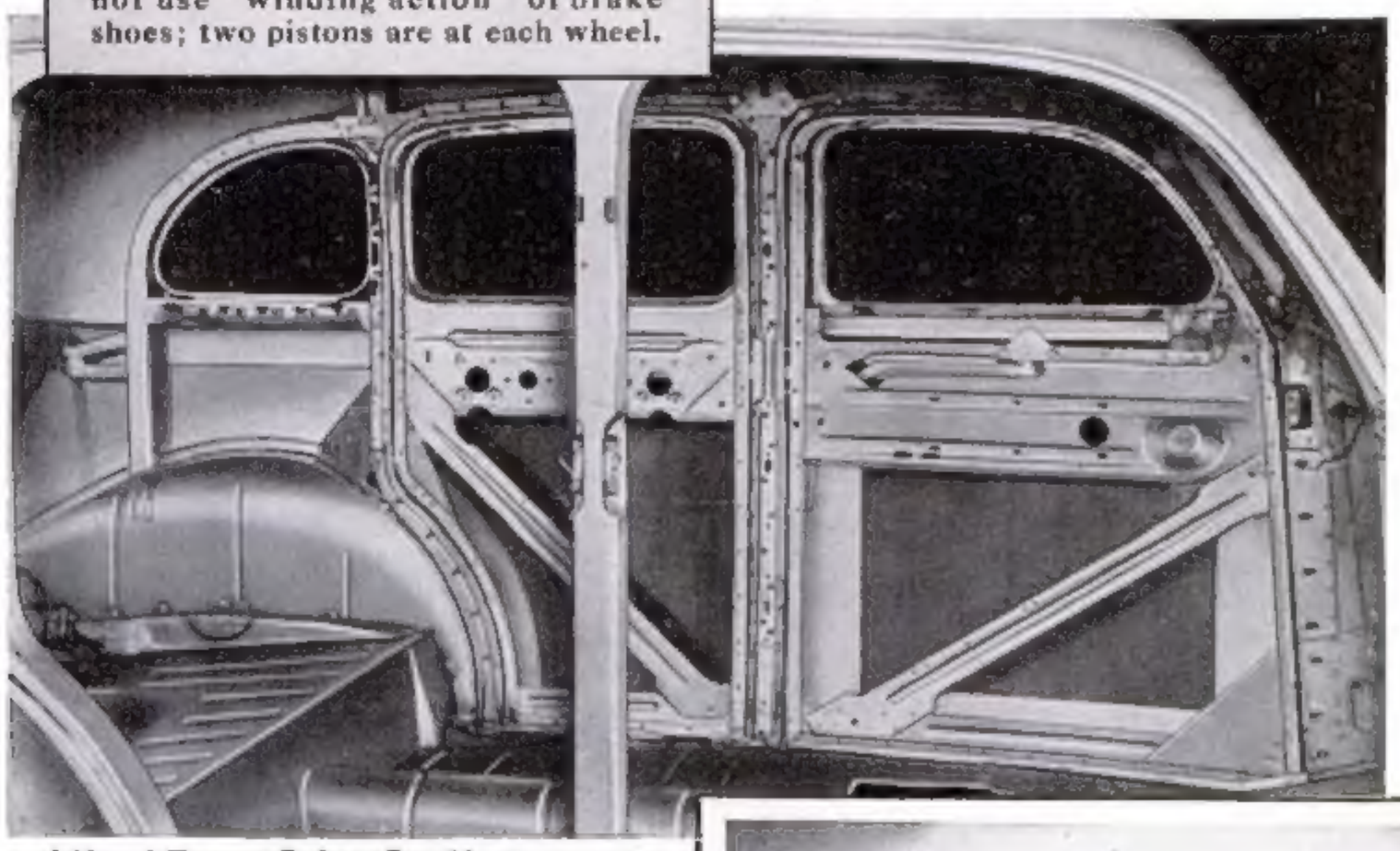

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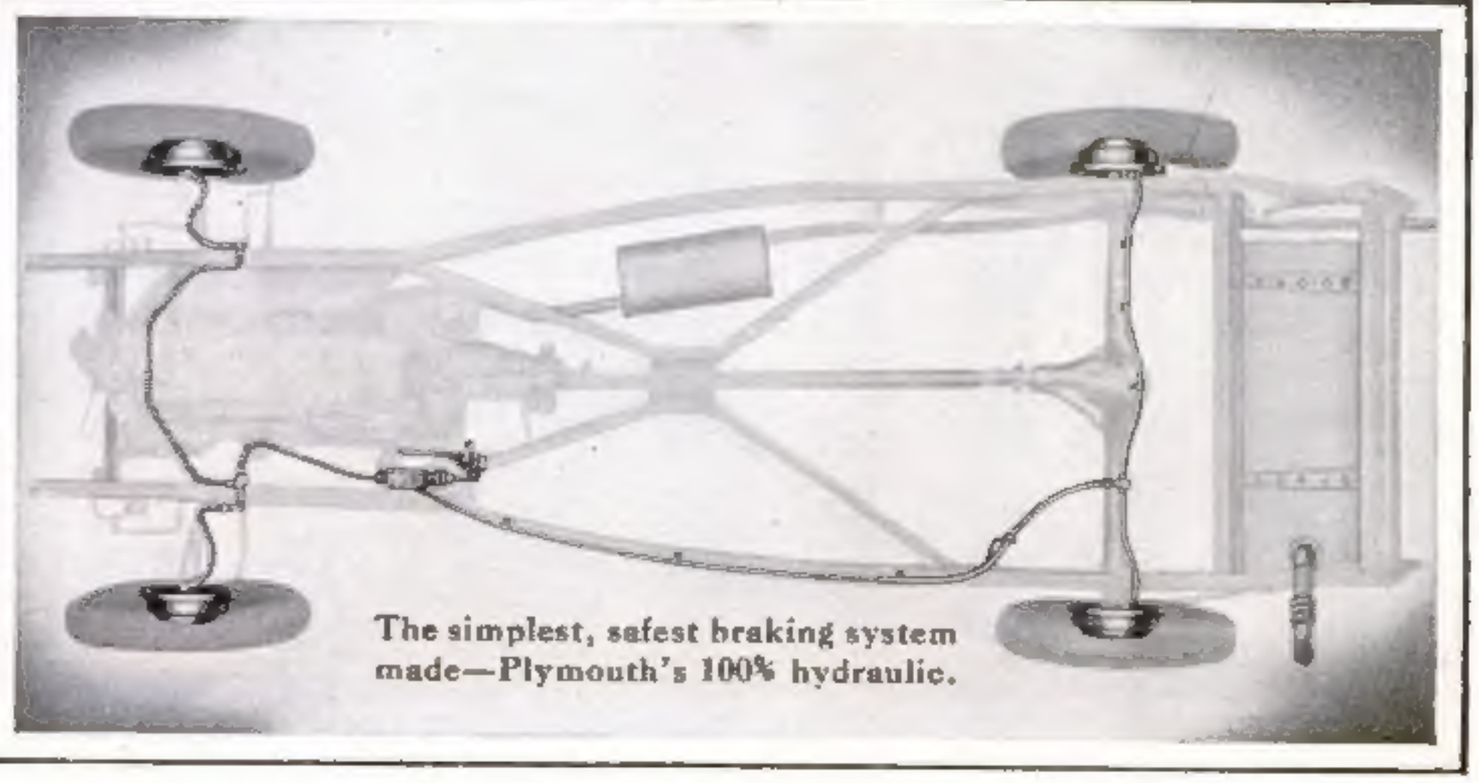

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FEATURES AND DEPARTMENTS

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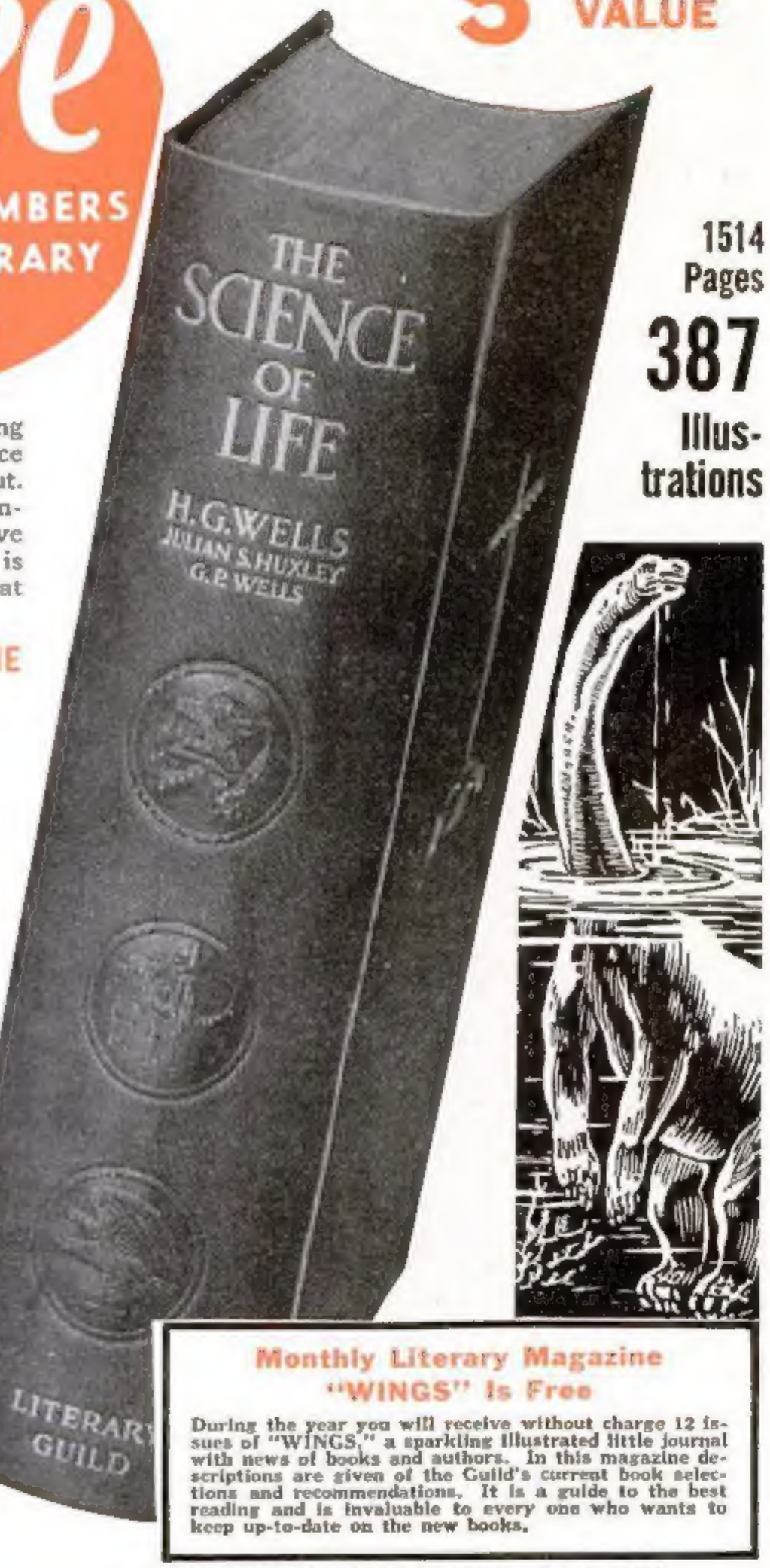

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Evidence of the Rocks
Man's Body
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FOR THE
HANDY MAN

Leak clamp taken apart to show special hinge

EMERGENCY LEAK REPAIR

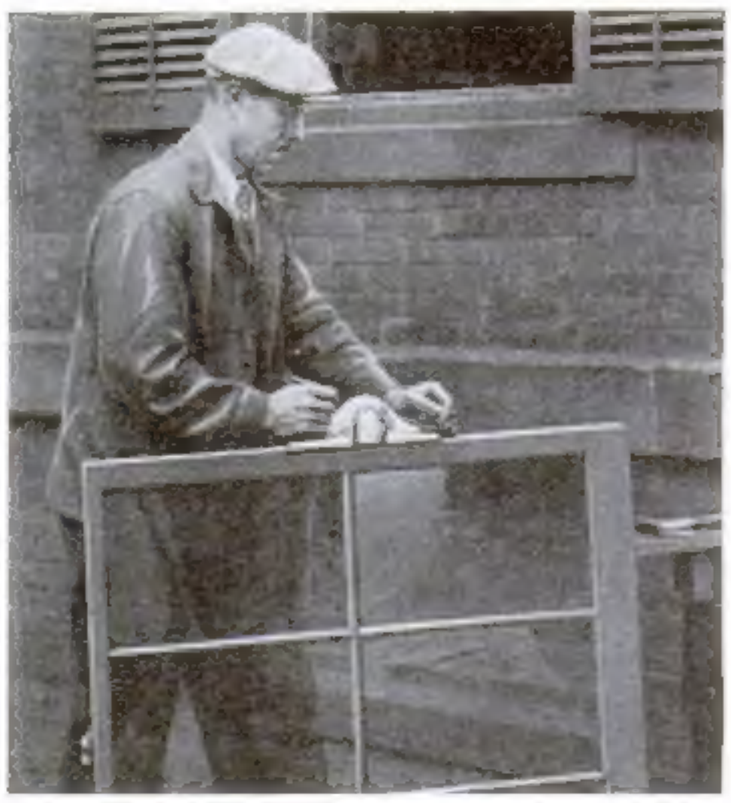
EMERGENCY repairs to leaky pipes can be made quickly and easily with a new type of inexpensive clamp. Sold in a variety of sizes, it can be used effectively on either water, steam, or ammonia pipes in both high- and low-pressure systems. An easily assembled interlocking hinge makes it possible to apply the unit in close quarters, as shown above. Two bolts hold the clamp firmly in place, pressing a special rubber gasket against the leak.

NEW CEMENT BRUSHES ON

BECAUSE it can be applied with a brush instead of a trowel, a recently developed cement simplifies the problem of pointing-up and weatherproofing old mortar joints in brick walls. No cutting or chipping is necessary, according to the manufacturers. Sold in powder form, the cement is simply mixed with water and applied to the joints with a small paint brush trimmed to fit the crack.

TINY ELECTRIC OUTLETS

WITH a new line of midget electric-wiring devices now being manufactured, it is possible to assemble a combination wall plate to meet any requirement. The units are so constructed that they are easily gauged to form any type of combination from a single switch to a series of switches, outlets, and pilot lights. With only twenty basic parts, more than 59,000 combinations can be made.



WEATHER-STRIPPING TOOL

RESEMBLING a plane, an electric weather-stripping tool now makes it an easy matter to provide the necessary grooves in window sash. Operating at high speed on either alternating or direct current, the cutter plows a smooth groove to take the projecting weather-stripping fin, providing an easy-sliding joint. A special attachment also makes it possible to use the tool to rabbet the window frame for the base of the weather stripping.

Questions

FROM HOME OWNERS

Q.—I HAVE been having trouble with a grayish discoloration under the window sills on my white house. Do you suppose the black paint I have used for the trim runs when it rains? Can you suggest a remedy?—H. R., Roselle, N. J.

A.—IT IS POSSIBLE that the black trim is causing your trouble. Oil paints wear off by degrees and the microscopic particles wash away when it rains. As a temporary remedy, try scrubbing the discoloration with linseed-oil soap. As a white house is always somewhat of a problem, we would suggest repainting the trim a lighter color.

WHEN WATER PIPES RUMBLE

D. C. S., CLEVELAND, O. Rumblings and rattlings in water pipes generally can be traced to one or more of the following causes: Loose or worn parts in a valve or faucet, loose or hanging pipes that vibrate, and lack of air cushions.

CLEANING OLD BRASS FAUCETS

Q.—I HAVE some old brass faucets that defy the ordinary methods of cleaning. Have you any high-powered formulas?—T. E. A., Boston, Mass.

A.—NITRIC ACID (one part) and sulphuric acid (one-half part) make a strong cleaning solution for old brass. Mix in a stone jar, dip the brass faucets into it, and finally wash them thoroughly in clear water. All inner parts, such as the stem and washer, should be removed, of course, before the faucets are dipped.

DIRT CAUSES FOAMING BOILER

W. E. C., SPOKANE, WASH. Foaming and an unsteady water line in a new boiler is caused by the accumulation of dirt, grease, and oil that gets into the system during manufacture and assembly. This sludge can be removed by "blowing-off" the boiler under pressure.

TILE REQUIRES SPECIAL MORTAR

R. G., AUGUSTA, GA. Mortar for use with hollow tile should be made a trifle richer than for ordinary purposes. A good mix contains one part cement, three parts fine sand, and one-half part lime.

DULLING GLASS-FINISH VARNISH

Q.—THE WOODWORK in our new house has a high-gloss finish. Is there any way that I can dull it down without completely refinishing it?—B. C., New Haven, Conn.

A.—A GLOSS varnish can be toned down into a beautiful semidull finish by rubbing the woodwork with pumice stone and oil. The rubbing should be done with a soft cloth pad, dipped first into a shallow container of oil and then into powdered pumice. Rub lightly and with long, even strokes.

HEAT MORE COSTLY THAN POWER

P. D. A., JERSEY CITY, N. J. As a general rule, home electric heating appliances draw more current than motor-driven appliances. The average washing-machine motor, for instance, rated at one-quarter horsepower, draws less than two amperes, while an ordinary electric iron draws about four amperes. The cost of operation is proportional to the current drawn.

FILLING CRACKS IN MARBLE

H. K., BUFFALO, N. Y. Cracks in marble can be filled with a cement made by mixing beeswax (eight parts) with resin (one part) and a small quantity of powdered marble. Push this into the openings and then rub in more powdered marble to smooth over the joint and give the surface a finished appearance.

Our Readers Say

Then, We Suppose, Will Come The Censor of Smells

Is IT practical to add the use of another sense to the realistic enjoyment of motion pictures? In the days of the silent movies, they laughed at talking pictures. Now I suppose you will laugh at smelling pictures. Today you see a fire in a motion picture and you hear the crackling of the flames. Why not smell the smoke? Here is my idea: the smoke could be compressed in tanks and a valve automatically opened to emit an adequate amount of smoke at the proper moment. Ventilators could quickly rid the theater of the smoke. Similarly, other odors could be employed in the same way to heighten the realism of many other scenes. What do you think?—A.M., Bridgeport, Conn.

In Search of a Model Home For His Bees

THE article on cast resins in the November number interested me very much. I bought some castings recently and found them easy to work with—so easy that I hope you will run more articles on this subject. Now I have a little request of my own which should interest thousands of your farmer readers. I would appreciate an illustrated article telling how to construct the most highly approved type of beehive that has been developed to date.—B.F.O., Moccasin, Ill.

Wants To Keep Abreast Of Fast-Moving Diesels

BEING a regular reader of your magazine, I have found it to be one of the best for the mechanic and engineer. However, like many other readers who are engineers or machinists, I am working with Diesel engines and would appreciate a department devoted to the Diesel engineer—such a department to cover new engines, developments, and operating hints.—G.S., San Diego, Calif.

Aiming To Give the Kettle An Everlasting Shiner

EVERY month when I receive my copy of POPULAR SCIENCE MONTHLY, I read the department headed Our Readers Say. In it there appear many questions for which the writers are seeking solutions. I have a question I would like to ask. Does any reader know how to keep a copper kettle shiny after it has been polished? I would certainly like to know as we have one which has to be cleaned every few days. It seems to me that somebody surely must have found a way around this difficulty. —R.T., Mobile, Ala.

Suggests Bridge of P.S.M.'s On Highway of Knowledge

IT HAS occurred to me that POPULAR SCIENCE MONTHLY does not confine its scope to chemistry, physics, and microscopy but covers many other subjects as well. For some time I have been aware of the lack of suitable media for bridging the gap between elementary science and the more advanced fields. But there is a widespread desire to acquire this knowledge. I noticed at A Century of Progress in Chicago that great interest was shown at the scientific demonstrations. It would be appreciated, I believe, if you would give us articles on electrostatic generators, piezo-electricity, and high-frequency sound waves.—L.Z., Chicago, Ill.

Well, Ether It Is Or It Isn't

RECENTLY I read a statement that matter may be a different, more solid form of ether. Turning this thought over in my mind, I have reasoned that ether might be composed of free electrons and free protons which, by equal attraction and repulsion, remain equidistant. The wave theory of light and radio would, I believe, hold true to this conception because, in the case of radio, the aerial, when it is negatively charged and emits electrons, repels the electrons in the ether and attracts the protons. When the aerial is positively charged, the reverse is true. Such a reaction would cause a backward-and-forward wave instead of the up-down-and-sidewise wave of present theories. In the case of incandescent materials, electric waves would be emitted in the same manner, but they would be of much higher fequencies. This ether-matter hypothesis would also check with the idea that ether fills all space—even a vacuum—because electrons and protons can pass between the atoms of the substance which contains the vacuum. Maybe some reader could tell me if such a theory is tenable.—K.McL., La Grange, Ill.

He'd Put Gus Wilson And Auto Kinks Back to Back

DURING the years I have subscribed for P.S.M., I have read with particular interest the articles on automobile mechanics by Mr. Bunn and the pages of handy kinks or ideas for car owners. I have been clipping these pages and have made a separate file of them. I always keep it with me when on a tour. But in making this file, the trouble is that the handy ideas and the Gus-and-Joe story appear on widely separated pages. It is my request that these two pages appear on the same leaf of the magazine. This means that if Mr. Bunn's article is on an even-number page, the ideas for car owners should be on the preceding odd-numbered page or vice versa. If this is done, readers, like myself, will not have to cut two leaves (excluding the continued columns) from the magazine and our files will be fifty percent thinner.—A.A.B., Kohlapur, India.

Taking a Microbe's-Eye View, That Stamp Is Mighty Thick

WHEN we read in the newspapers that a balloon has risen into the stratosphere to a height of fourteen miles above the earth, it sounds like a long, long way. However, being of a mathematical turn of mind, I decided to visualize the feat of Captains Stevens and Anderson by comparing the earth with an orange. Using an orange of three inches diameter, I found that the altitude reached by the balloon would be, comparatively, about .005 inches, or approximately the thickness of a postage stamp. So, if any of your readers would like to see how far men have succeeded in raising themselves off the earth, all they have to do is to stick a stamp on an orange. It's still a long way to Mars, or even to the moon.—J.B.B., Rahway, N. J.

A Phonograph and Refrigerator Are on His To-Be-Built List

AS A subscriber and reader for ten years (some interruptions as a subscriber, but few as a reader), I have enjoyed most of the departments in your magazine telling how to make various things. Personally, I should like to see articles for the making of two items. One is an electric pick-up phonograph and the other is an electric, running-board refrigerator to be used while touring. I am particularly interested in the first and believe it would be of general interest.—P.R.F., Springfield, Ohio.

In Other Words, the String Would Really Go to Pieces

IN READING over the December issue, I came across the query of G.S., of Westbourne, Manitoba, Canada. G.S. wants to know what would happen if an equal pull were exerted at each end of a string of uniform strength throughout. In such a string, each fiber would have an equal hold on the fibers touching it. Therefore, the hold on each fiber would be the same at all such fiber-unions throughout the string. When the external pulling forces at each end of the string equaled the combined internal holding force of the fibers, the opposing forces would be balanced. Any increase in the external pull would overbalance this equilibrium and all the fibers would let go of each

other simultaneously. The string would become a cloud of fibers, falling to the floor. I know I can't prove it but neither can anyone unprove it.—S E W., Pittsburgh, Pa.

Amateur Chemist Puts Us In His Analytical Test Tube

FIVE YEARS' reading, almost constantly, of any magazine without offering a bouquet or throwing a brickbat is, in my opinion, some record. But I can resist the urge no longer. As an amateur chemist, I feel obliged to offer an analysis rather than a list of kicks It goes something like this: (1) Feature articles—very high quality and large percentage present; (2) Gadgets—present in overwhelming amount; (3) Microscopy department—on the whole, good, but isn't the field large enough so that repetition is not necessary? Let's have more on staining and technique; (4) Radio department—as a ham, I may be qualified to vote 100 percent; (5) Workshop—very fine; (6) Photography—good but present in too small quantities; (7) Chemistry—practically a negative quantity. Most of us have done these experiments in high school or earlier. Chemical apparatus is so cheap that there is little excuse for pickle-bottle apparatus. And lastly, please give us something on pipe organs.—E.L.J., Kankakee, Ill.

Though Dead, He Became Champion Plant Patentee

AFTER reading the article, "Meet the Champion Inventors," in the January number, I wondered how many of your readers are aware of the fact that there is a law governing plant patents. Your story brought out the fact that an unknown inventor was the champion of living patentees but the surprising fact in the realm of plant patentees is not that Luther Burbank received the greatest number of these patents, but that all of them were granted to him after his death! The plant patent law was passed after Burbank had died and the patents were awarded to his estate through his executrix, Elizabeth Waters Burbank.—A B R., San Diego, Calif.

Few Sounds Would Sound Good To This Reader

IN THESE days when people are becoming aware of the harmful effects which noises have on their health, I think the time is ripe to legislate the worst noises out of existence. Technicians are able, through recent scientific developments, to set up a neutralizing noise in opposition to an offensive noise so that no sound is heard. Why, then, is it not practical and feasible to enact Federal or state laws requiring that such sound-neutralizing devices be installed on all machinery or devices which cause a noise exceeding a certain number of decibels? The cost of such a program, I think, would be offset in industry by a higher efficiency of the employees and in the city homes and streets by an immeasurable improvement in health and living conditions. Now don't ask me how about automobile horns, whistles, etc. I am not thinking of a soundless city or a silent factory but an environment with a sound level not exceeding a set number of decibels—S.N., New York City.

World's Largest Grinder Recalls Childhood Toy

I'M STILL a bit dizzy from trying to visualize all the five motions of that big tool they're going to use to grind the 200-inch telescope mirror, described in your December issue—and my hat is off to the fellow who had the Einsteinian mind to invent it! Looking at the pattern of interlacing curves traced with the tool, I was struck with the resemblance to designs that children used to make with a toy called the "wondergraph" or some such name. It was a little wooden gadget with several flat wheels and, when you turned one with a crank, a moving pen traced all kinds of ornate designs on a piece of paper tacked on a holder. I haven't seen one in years; perhaps they're gone the way of the family album and the parlor stereoscope. It ought not to be hard to make one, though, and I'd like to put one together for my kids to play with (maybe me, too). If you can dig up the dope on this device, why not publish plans in your Home Workshop Department? I believe that machines working on the same principle, called "rose engines," are used for producing the ornamental patterns on bank notes and stock certificates.—A.R., New York City.

The Expression May Be Wooden But It Speaks for Itself

THIS is the first time I have felt impelled to write to any magazine concerning the contents of their publication. I am doing so now to thank you for the article on the character carving of Skipper Sam'l. I have whittled three of these characters, each one being an improvement over the preceding one. It seems that, should I elect to make a dozen of them, each would be slightly different in facial expression or carriage from the others. I hope you can find space in future issues for similar articles. I am mainly interested in handicraft and wood-working but also enjoy the articles on microscopy and nature studies.—W.C.W., Homewood, Ill.

We Hear of the Accidents Only, Says Air-Travel Enthusiast

HERE'S a letter I hope you will print. Too many people are judging air-line safety by accident headlines. A few spectacular crashes, in their minds, blot out the regular routine, unspectacular flights that go on day after day, the year around. A timely report of a U. S. Senate investigating committee has just been published. It shows by figures that airline travel today is three times as safe as it was just ten years ago! Lindbergh's flight to Paris convinced millions of people that air travel was safe and practical. The network of airports, humming with activity, throughout the country has made air travel seem matter-of-fact to these same millions. Now with airlines three times as safe and a dozen times as comfortable, there is only one excuse for not using them—the expense. And, with increased patronage, the cost of air travel is bound to drop.—B.T., St. Louis, Mo.

Defenders of Eagle Get the Bird

I was interested in reading, in your department "Here's the Answer," your defense of the eagle against the charge of kidnaping children. However, a few days later I saw in a newspaper a bulletin which went even further Not content with whitewashing our national bird, it went on to say that if there ever was any trouble between children and eagles, it was probably because the children annoyed the birds. Now, it's all right to hold to the belief that a bird can do no wrong, but they have no right to blacken the reputation of American childhood by insinuating that our kids go around attacking innocent bald eagles which have no thoughts of seizing youngsters. I think they owe the children an apology.—J J.B., Asheville, N. C.

Human Alarm Clock Cheats Clock of Its Morning Ring

MAYBE some of the psychology sharks among your readers can help me to clear up a little mystery. For years, I have been using an alarm clock to wake me up in time to get to work but, to the best of my knowledge, the bell on the thing has never rung once. No matter what time I set the alarm for, I am sure to wake up just a few minutes before it is due to go off. Something about setting the alarm seems to set another alarm in my subconscious mind. As sure as I forget to set the alarm, I sleep right through my usual waking time. Is there some kind of telepathic connection between me and the clock?—A K., Schenectady, N.Y.

There's a Time and Place For Everything—Even Chess

I NOTICE a letter from V.S.H., of Jerseyville, Ill., wherein he suggests a chess problem. Shades of Paul Morphy! I am afraid that V.S.H. will never live to see his suggestion materialize in any magazine other than one devoted solely to chess. I'm afraid, too, that the greatest game ever devised by man is doomed to continue on in the everlasting struggle of a pitiful existence. Only the remarkable nature of this fascinating game (which isn't a game at all but a mighty battle of mental powers) can account for its longevity among a people with so many passing fads.—S.S., Williamsville, Ill

One of Our Hand Looms Is Going to School

I AM very much pleased with the plans of the hand loom which appeared in the October number. My wife and I built one of these looms and hope to have it in operation soon at the occupational therapy department of the Michigan State Farm Colony. I wish you would now print plans for a medium-sized table loom which could be built as readily as the other.—C.J.L., Caro, Mich.

In the Days When We're All Senoras and Señores

YOUR reader F.A., of Toledo, Ohio, in the December number asks for suggestions for a universal language for radio listeners. In my judgment, the ideal language for this purpose is Spanish. I say this because it is the purest form of Latin used today and it is the easiest to acquire. The rules governing its use are few. Fully one half of the inhabitants of the western world speak it. A teacher of languages, who spoke fourteen languages, has said that a working knowledge of Spanish could be acquired in three months, whereas it would take three years to make the equivalent progress in the study of English.—R.P.D., San Antonio, Texas.

"My dad says 'complete' means CHEVROLET!"

com-plete' (kŏm-plēt') a. 1. With no part, item, or element lacking; free from deficiency; entire.

—Webster's Dictionary

THE young man's dad is right! **For, of all cars in the entire lower price range, the new Chevrolet is the *only* car that is really and genuinely complete. It's the only car that brings you *all* the features that are essential to complete motoring enjoyment. This word "complete" is the only word that fully describes the new 1936 Chevrolet; and it has come to *mean* Chevrolet to buyers of cars in the lower price field. See your Chevrolet dealer—*today!***

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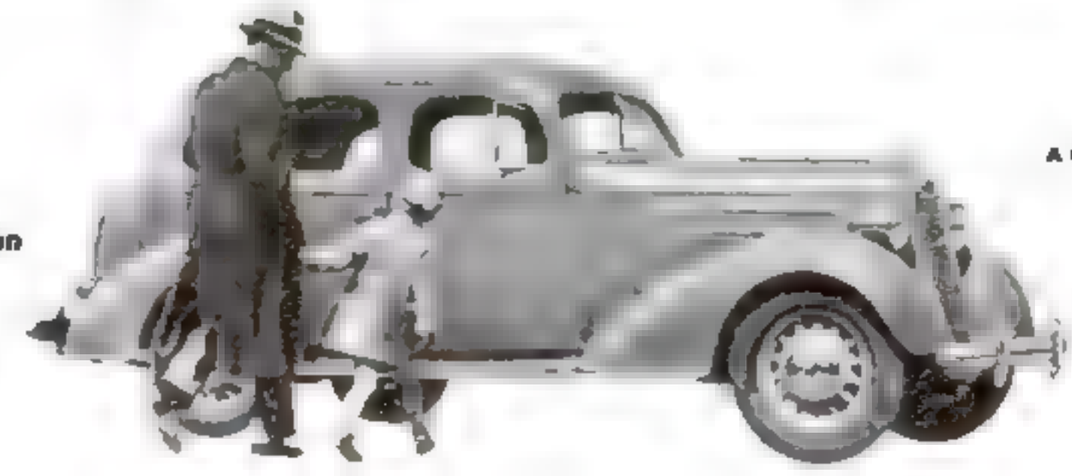
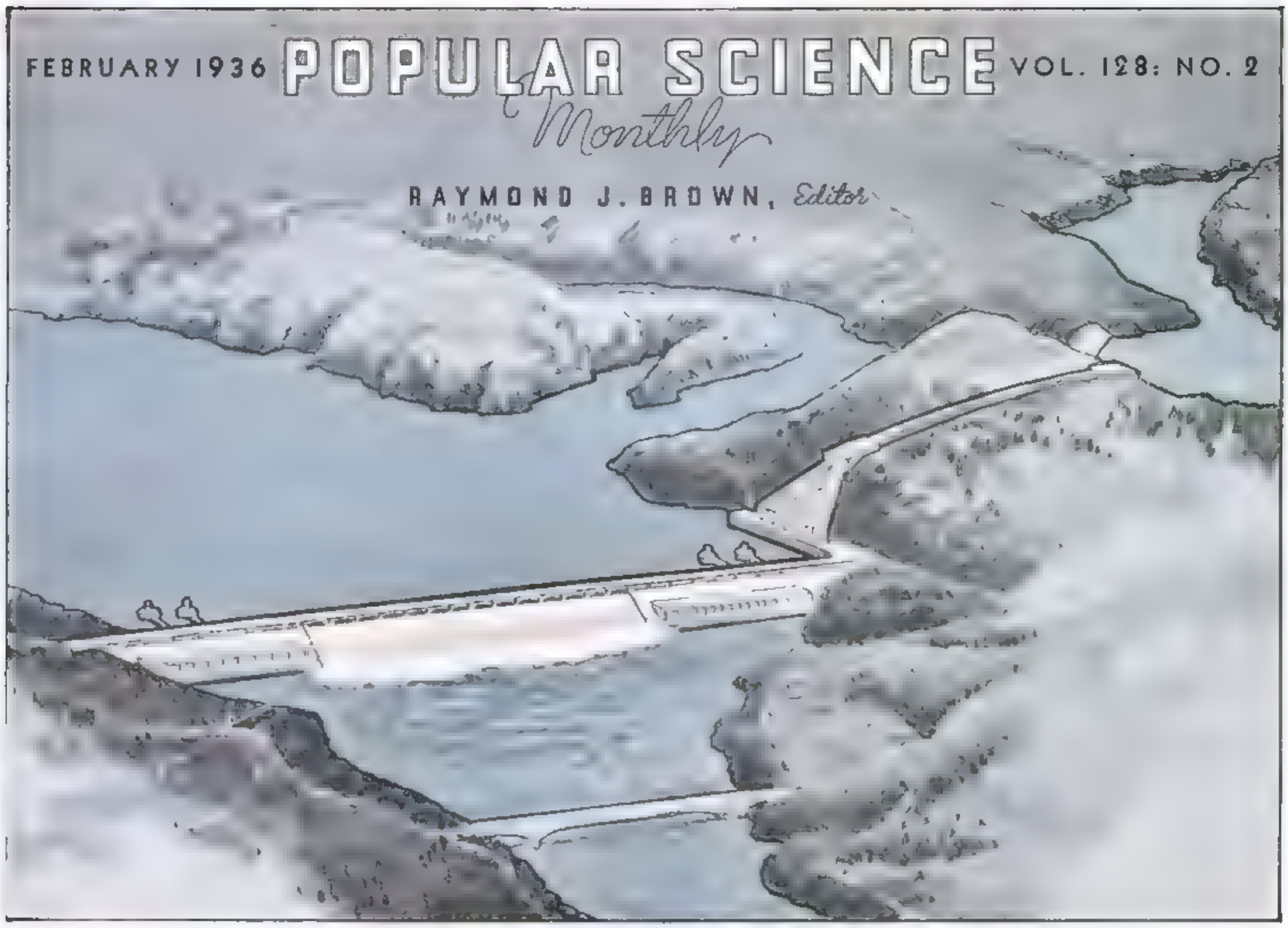


Master De Luxe Sport Sedan

CHEVROLET
A GENERAL MOTORS VALUE

FEBRUARY 1936 POPULAR SCIENCE Monthly VOL. 128: NO. 2

RAYMOND J. BROWN, Editor



How the Columbia River will be harnessed for power and irrigation. The Grand Coulee storage reservoir is seen in the upper right-hand corner

World's Greatest Dam

TO CREATE AN ELECTRIFIED PARADISE • •

By Walter E. Mair

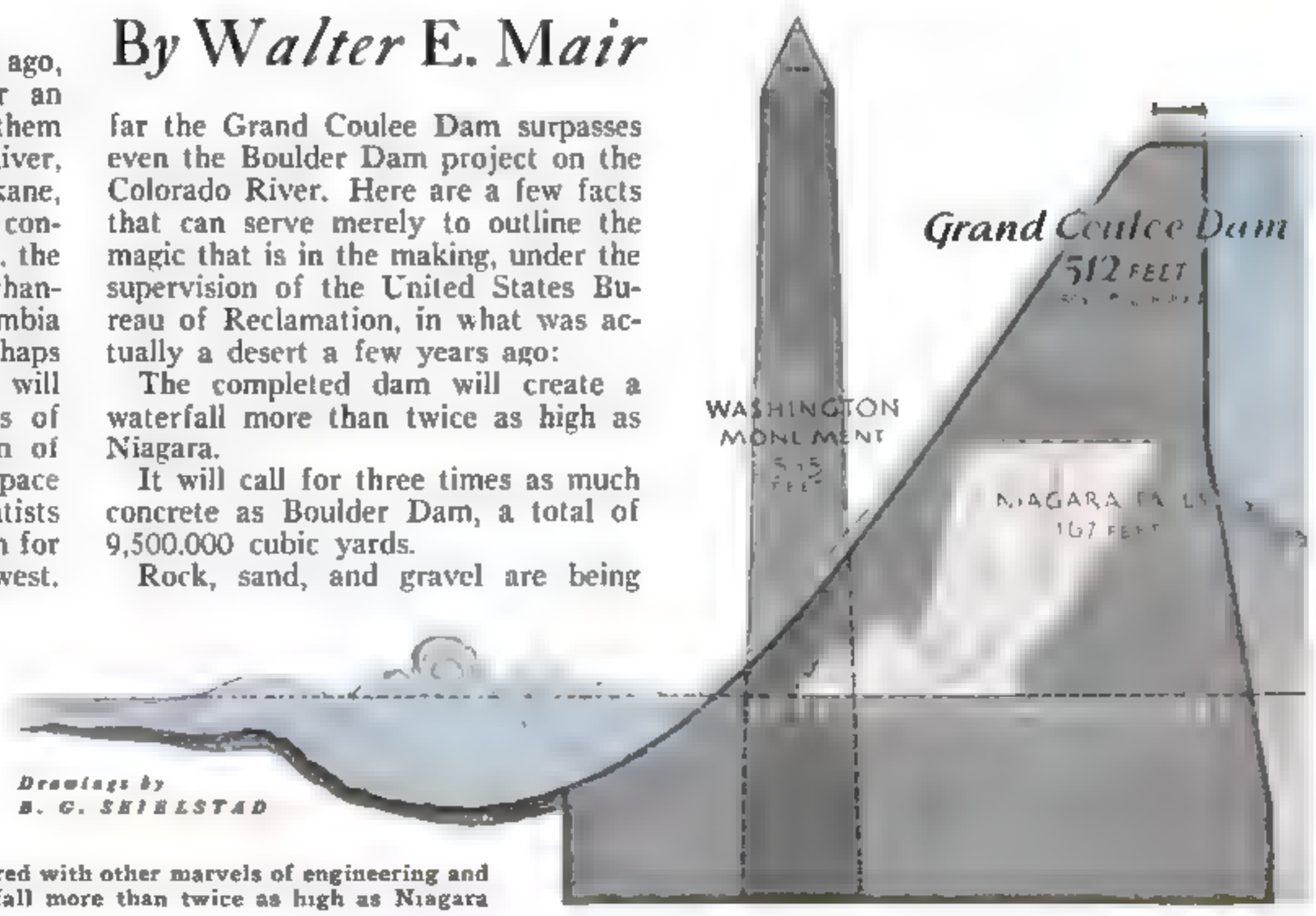
WHERE, thirty months ago, lone ranchers waited for an antiquated ferry to take them across the Columbia River, ninety-two miles southwest of Spokane, Wash., engineers are today pouring concrete for the greatest dam of all time, the Grand Coulee. Named after an old channel of the river, to which the Columbia was diverted by glacial action perhaps half a million years ago, this project will eventually transform 1,200,000 acres of practically desert land into a region of immense fertility. And it will set the pace of the new electrical era which, scientists and industrialists agree, will first dawn for the average man in the Pacific Northwest.

Comparisons with other engineering achievements, as well as with the wonders of nature, are so awe-inspiring as to stagger the imagination. Not until you have actually seen its immensity, its day-by-day development, can you realize how far the Grand Coulee Dam surpasses even the Boulder Dam project on the Colorado River. Here are a few facts that can serve merely to outline the magic that is in the making, under the supervision of the United States Bureau of Reclamation, in what was actually a desert a few years ago:

The completed dam will create a waterfall more than twice as high as Niagara.

It will call for three times as much concrete as Boulder Dam, a total of 9,500,000 cubic yards.

Rock, sand, and gravel are being



The Grand Coulee Dam compared with other marvels of engineering and nature. It will create a waterfall more than twice as high as Niagara

One of the cellular-sheet cofferdams with which the low winter stream of the Columbia is being confined

produced at the dam site by the largest plant of its kind ever assembled, electrically driven.

Although the estimated cost of the Grand Coulee Dam and its power plant is only about $190,000,000, a total expenditure of $393,000,000 will be required to build and put into full operation the reclamation program which is expected to provide ultimately 30,000 highly modernized, fully electrified, forty-acre farms. These are expected to furnish ample resources, with crop rotation and the building of at least four major industrial communities, to support an additional population of 1,500,000 people.

This program will require the installation of eighteen generators with a horsepower rating of 146,000 each, or a total of nearly three million. These giant units, operated on sealed phosphor-bronze bearings, are expected to be capable of being maintained without more than minor servicing for from forty to fifty years, because of the fact that the intakes will admit water that is practically free from suspended minerals, grit, and other elements that would tend to wear out the machinery.

Secondary power will be employed to operate twenty giant pumps which will lift water 310 feet from the pool formed by the dam, through a canal nearly two miles long, into the Grand Coulee irrigation reservoir. Each of these pumps will be driven by a 33,000-horsepower motor, and, in effect, they will operate as so many generating turbines running in reverse.

In other words, the mighty Columbia, thrashing and thundering its way more than 1,200 miles from its source in British Columbia to its mouth at Astoria, Ore., will be so harnessed in this deep-carved, granite-walled gorge that it will literally turn back the wheels of time at least 300,000 years. It will lift itself back into that tremendous canyon where once it flowed, blotting out little settlements, covering worn and dusty upland roads.

When you realize that the annual run-off at the mouth of the Columbia is ten times that of the Colorado, which the Boulder Dam controls; its drop 2,650 feet from its source to the sea, you can understand why the river once misnamed by a poet "the mighty Oregon" is the greatest power stream in the civilized world.

In the section between the Canadian line and its mouth, where the net fall is 1,300 feet, this stream, without harnessing any of its tributaries, can be made to generate one third as much electric power as was produced in the United States for all purposes in 1930!

Considering this, a few comparisons with the job man has done at Boulder Dam, and of the tremendous tasks for which the latter and the Grand Coulee are intended, are none the less startling. Although Grand Coulee will not be so high, by 230 feet, as Boulder Dam, it will have a crest length of 4,100 feet, nearly four times that of the Colorado River project. Its construction will require 16,000,000 cubic yards of excavation, as compared with 7,000,000 at Boulder Dam. It will develop a total of 2,646,000 horsepower, against the 1,835,000 horsepower load to which the turbulent Colorado will be yoked.

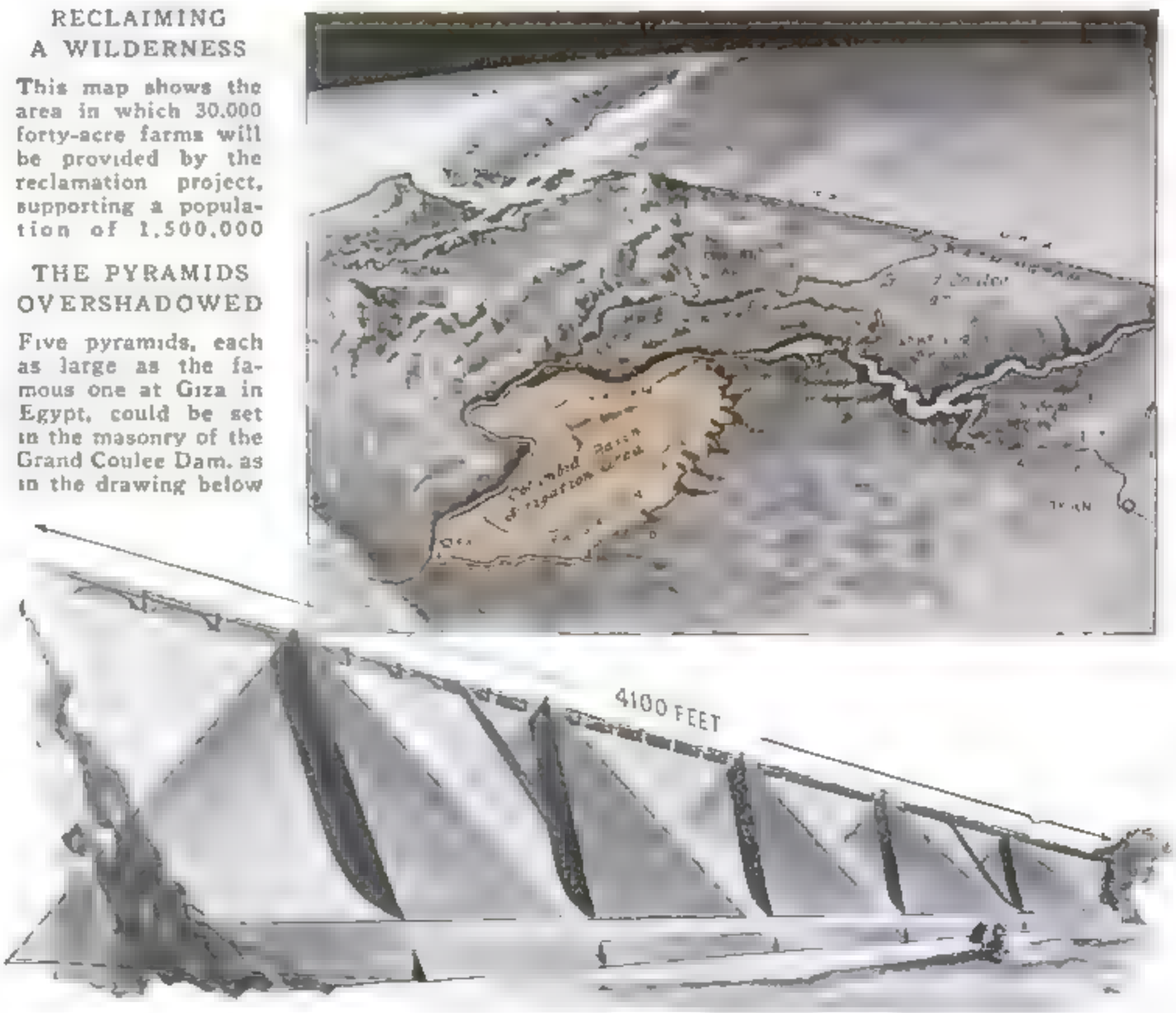
How was this "eighth wonder of the world," as it has been called, brought into being? It happens to have been the writer's good fortune to know several of the citizens of Washington State who have pressed for a favorable decision by Uncle Sam on this project in years when it looked as though the sprawling waste that was the Central Columbia Basin might remain forever a sage-dotted desert. Among these was James O'Sullivan, now secretary of the Columbia Basin Commission, formerly a mathematics teacher and civil engineer. He, as much as any one man, followed the project through until Uncle Sam turned it over to Dr. Elwood G. Mead, of the U. S. Reclamation Service, with the order to

RECLAIMING A WILDERNESS

This map shows the area in which 30,000 forty-acre farms will be provided by the reclamation project, supporting a population of 1,500,000

THE PYRAMIDS OVERSHADOWED

Five pyramids, each as large as the famous one at Giza in Egypt, could be set in the masonry of the Grand Coulee Dam, as in the drawing below



"carry on" with the gigantic undertaking.

Merely to hint at the romance, the grim battle that led to final endorsement and financing of the project, there was one winter when O'Sullivan, down to his last dollar, borrowed enough money to mount an oil stove in the back of a rickety old limousine. In this car he plowed through snow and sleet and boggy roads, pleading with the citizens of one little town after another to help get the state behind this dream of half a century. A milliner donated five dollars a month from her scanty earnings, for a year. A depression-haunted banker in a tank village took his last Liberty Bond from his private safe, to help convince the legislators at Olympia that Grand Coulee, proven sound engineering after years of bickering and contrary reports, must be made a reality.

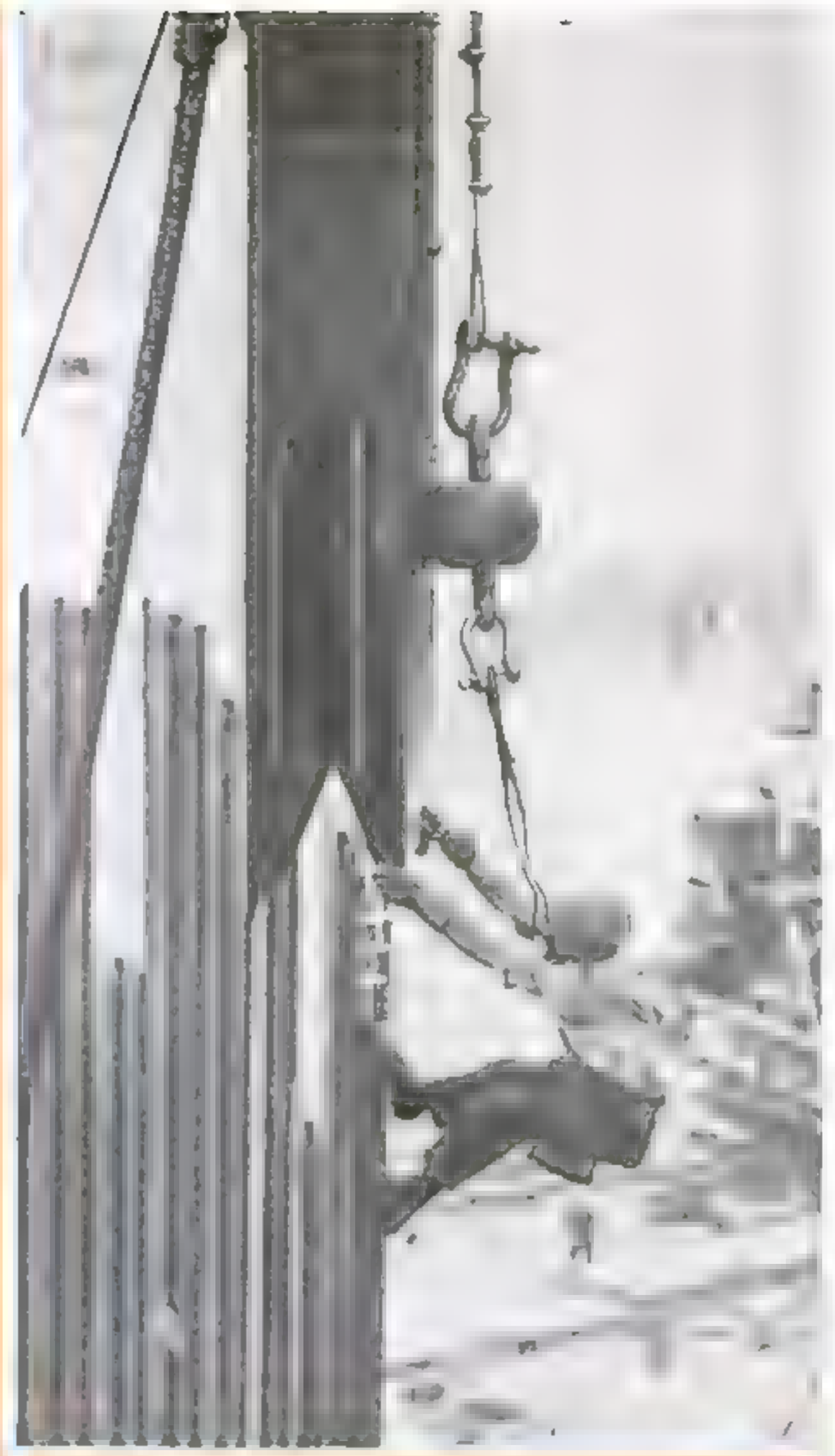
For fifteen years, state, Federal, and private engineers had wrestled with the problem. Finally, the U. S. Army engineers recommended a comprehensive plan for developing the Columbia to provide for storage, navigation, flood control, power, and irrigation.

It calls for ten dams, including one at Rock Island, Wash., already built by private capital; Bonneville, close to Portland, Ore., and Grand Coulee.

"Two hundred and fifty feet to bed rock!" howled the engineers, when the building of Grand Coulee was proposed. As a matter of fact, the builders have struck bed rock well within 100 feet at nearly every point. Now let us review the picture as it stands, and try to imagine some of the transformation needed to create this giant among the world's dams:

During the last year, the contractors have faced the mightiest task in the history of construction and engineering. Diversion tunnels were too costly, and too risky, to handle the tremendous flow. So they have built a cellular-sheet cofferdam, 2,900 feet long, fifty feet wide, 110 feet high above bed rock —the greatest of its kind ever put in place—on the west bank. On the opposite bank another one, also of interlocking sheet piling, and to be filled with grout, cement, and earth, will help to pinch the low winter channel.

During the first year, with 3,500 men employed in the earlier stages, and a labor and technical staff running close to 7,000 at the peak, the work has involved such marvels as moving 60,000 cubic yards of earth and overburden from the dam site, railroad grades and other excavations, every day. This called for the largest belt-conveyor system ever built, running on sets of triple rollers and forming a moving trough five feet wide.



A worker guiding one of the huge steam hammers into position to drive piles strung for a cell of the huge 2,900-foot cofferdam

ELECTRICITY TRANSFORMS THE HOME

A kitchen at Mason City, equipped with all electrical conveniences. The drawing shows construction of experimental heat-storage oven to use off-peak current loads for heating in winter. At right, an oven installed for trial in a house at the dam-site village

A similar giant conveyor system several miles in length, integrated with a great gravel-pit installation at the top of a hill near the dam site, will haul sand and gravel to the largest sorting, washing, and distributing plant in history. The concrete-mixing plants have a capacity of 14,000 cubic yards a day.

But the method of controlling the river flow and maintaining steady progress in pouring the various blocks, or sections, is not quite so simple as a matter of capacity and speed of machinery. That has already been indicated by the shifting and sinking out of line of one of the caisson piers sunk for a railroad and highway bridge which was to have been completed last summer. This is about the only defeat the engineers have suffered so far, and they have redoubled their precautions as the major job progressed.

Their plan is to leave a series of "low blocks" in the west end of the dam, over which the river will be diverted. During low water, which means in the winter, these openings will gradually be closed and poured, and the dam "fingered up" to its requisite height.

To protect the bed rock at the toe of the dam against the impact of 25,000,000 horsepower of energy dropping over the spillway, is something to think about, too. This the engineers plan to do by providing a deep pool *(Continued on page 100)*

New Scientific Woodcraft

By
STERLING
GLEASON

"FIRE weather!" Hot winds, racing in from the desert during the closing days of last October, turned the wooded areas of Southern California to tinder. Even as rangers doubled their vigilance and closed danger zones to campers, fires flared at three widely separated points.

From a spot near the ocean, flames began to eat their way back along the bony ridge of the mountains north of Los Angeles. A second blaze swept up a canyon on the east; and farther south, fire crackled in the chaparral and crept rapidly down upon the outposts of a wealthy residential district.

Within a few hours, the city was ringed with flame. Mountain homes were wiped out. Deer and other frightened creatures ran wildly down to the ocean or fled into town, driven before the advancing flames.

As warning of the fire's outbreak was flashed from lookouts on surrounding peaks, Uncle Sam's forest army mobilized. Big trucks, laden with CCC men, roared up to the fire zone. Powerful pumps flung sheets of water against the onrushing flames. Ranged over a battle line stretching for many miles, thousands of men valiantly fought the fire—trenching, cutting brush, and back-firing. Airplanes soared overhead, reporting by radio the progress of the battle. U. S. Army officers established a virtual martial law to prevent pillaging, and Red Cross field hospitals and soup kitchens for refugees and fighters gave the fire zone a war-time appearance.

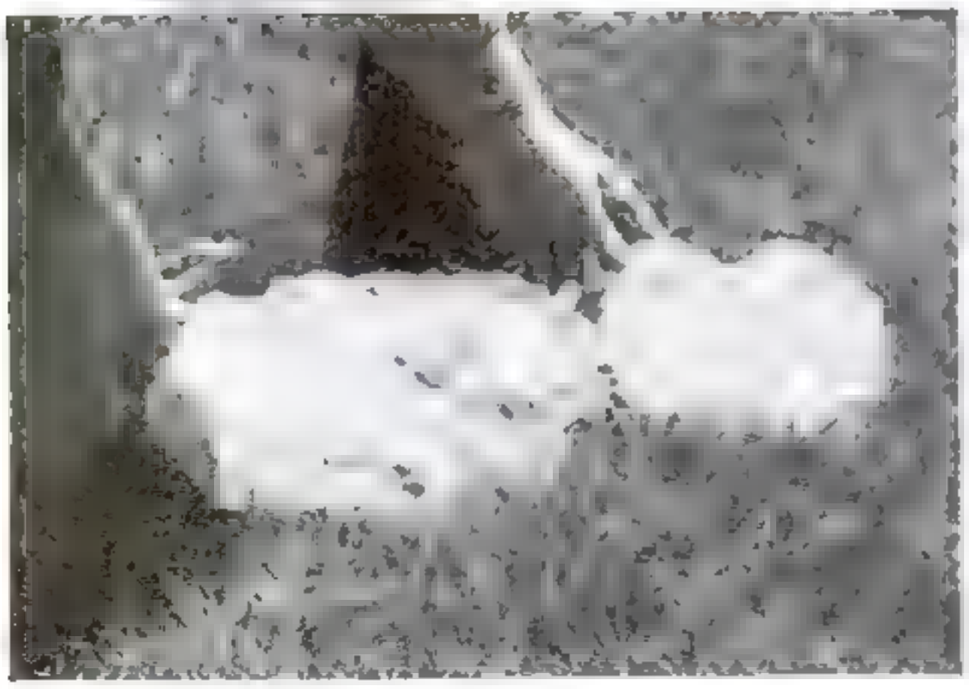
Back-tracking the fire through its wake of smoking embers came the Forest Service G-men—trained investigators who combine the magic of microscope, test tube, and camera with the secrets of Indian woodcraft, and possess a seemingly uncanny ability to detect the work of a fire bug and track him down. They quickly traced one blaze to a camper's carelessness; another, to a broken power line spitting flame as it fell. The third was incendiary.

Dim footprints in the dust led them to parallel tracks where an automobile had stood. They trailed the car out of the forest, obtained a description of the car and driver from a witness who had seen the fire bugs make their get-away, and caught one suspect still wearing shoes which

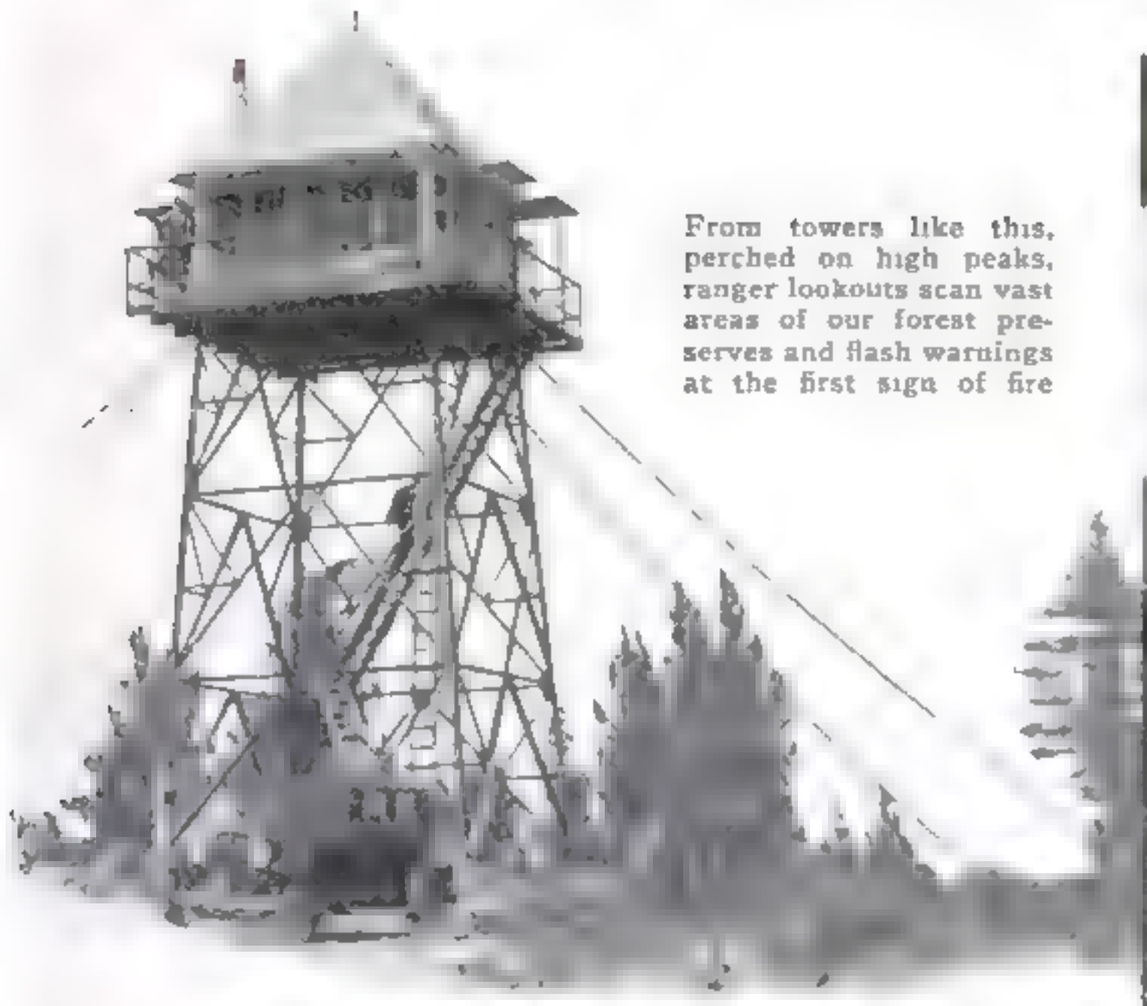
A ranger photographing footprints in dust before proceeding to make a plaster cast of them. If a forest fire is suspected to be of incendiary origin, every clew is followed

Building up the footprints with plaster of Paris. After the cast has set, measurements are made of the length of stride, as at left. Below, completed casts

Fire raging in a national forest, as photographed from an airplane. In addition to the watch kept from towers on mountain tops, aircraft have been pressed into service for fire-patrol work. In one instance, a pilot even spotted the fire bug at work



Traps Forest Fire Fiends



From towers like this, perched on high peaks, ranger lookouts scan vast areas of our forest preserves and flash warnings at the first sign of fire

At Forest Service fire headquarters, locations of new fires are plotted as reports come in from lookout stations. Exact spots are found by triangulation, using bearings given by several stations

matched the telltale footprints. Seventy-two hours later, their intricate trail of investigation ended when they took the second culprit into custody as he lay in bed in his Hollywood home.

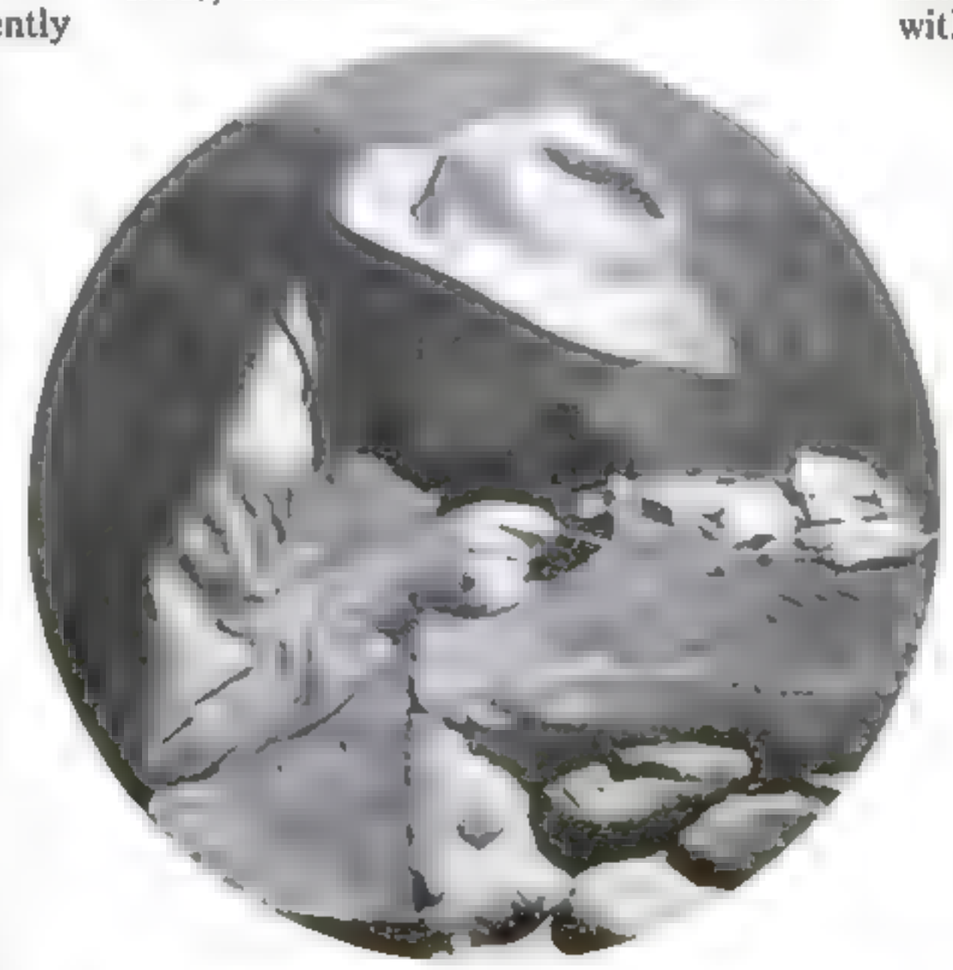
Tracking incendiaries is the work of a new arm of the Forest Service, organized to fight the criminals who each year cause disastrous fires to ravage the two hundred million acres of timber land under the government's care. Single districts have had as many as thirty incendiary fires in one season, some of them costing many thousands of dollars to suppress, not counting the living trees destroyed, the lives of brave fire fighters lost in the battle, and the damage done later by floods racing over denuded slopes.

The motive may be to settle a grudge against a neighbor by "burning him out," or to make jobs for fire fighters, although now the Civilian Conservation Corps has taken over this work. Ranchers frequently set fires to burn out the underbrush so that grass for their cattle will grow better, heedless of the fact that they burn out the humus, destroy roots, and start erosion that eventually will ruin the land.

One fire bug's criminal record was used by a group of cattlemen as a lever to compel him to set their fires. Another pair of incendiaries in a recent case were professionals who worked twelve miles apart, each planting fires at quarter-mile intervals. The fifty blazes they set quickly converted the whole area into a roaring inferno, resulting in one of the most disastrous fires of recent times.

The work of the fire bug has become a dangerous game since the G-men of the forest began operations. In some of the "hottest" districts, the number of incendiary fires has dropped to but two or three a year and, in almost every case, the guilty person has been tracked down.

These Forest Service experts combine the latest methods of crime detection with a thorough knowledge of the secrets of woodcraft. Most people would say there were no clews left in the charred desolation after a forest fire has roared past. But faint impressions in the dirt and ashes, pools of candle tallow, cigarette stubs, burnt matches, and other trifling bits of litter, mean clews to the forest G-men.



A woodsman sleuth makes a careful examination of clews found near the spot where an incendiary fire was started. Even a few half-burned match sticks may lead to an arrest

The first ranger at a fire carefully covers any footprints he may find with bark or boughs to preserve them until the investigator arrives from district headquarters.

Not long ago, a column of smoke puffed upward from the green depths of Shasta National Forest in California. Another followed, and another. Soon the Bonanza King lookout station had reported five fires within a three-mile radius. Supervisor Earl E. Bachman immediately suspected fire bugs and hurried an investigator to the scene.

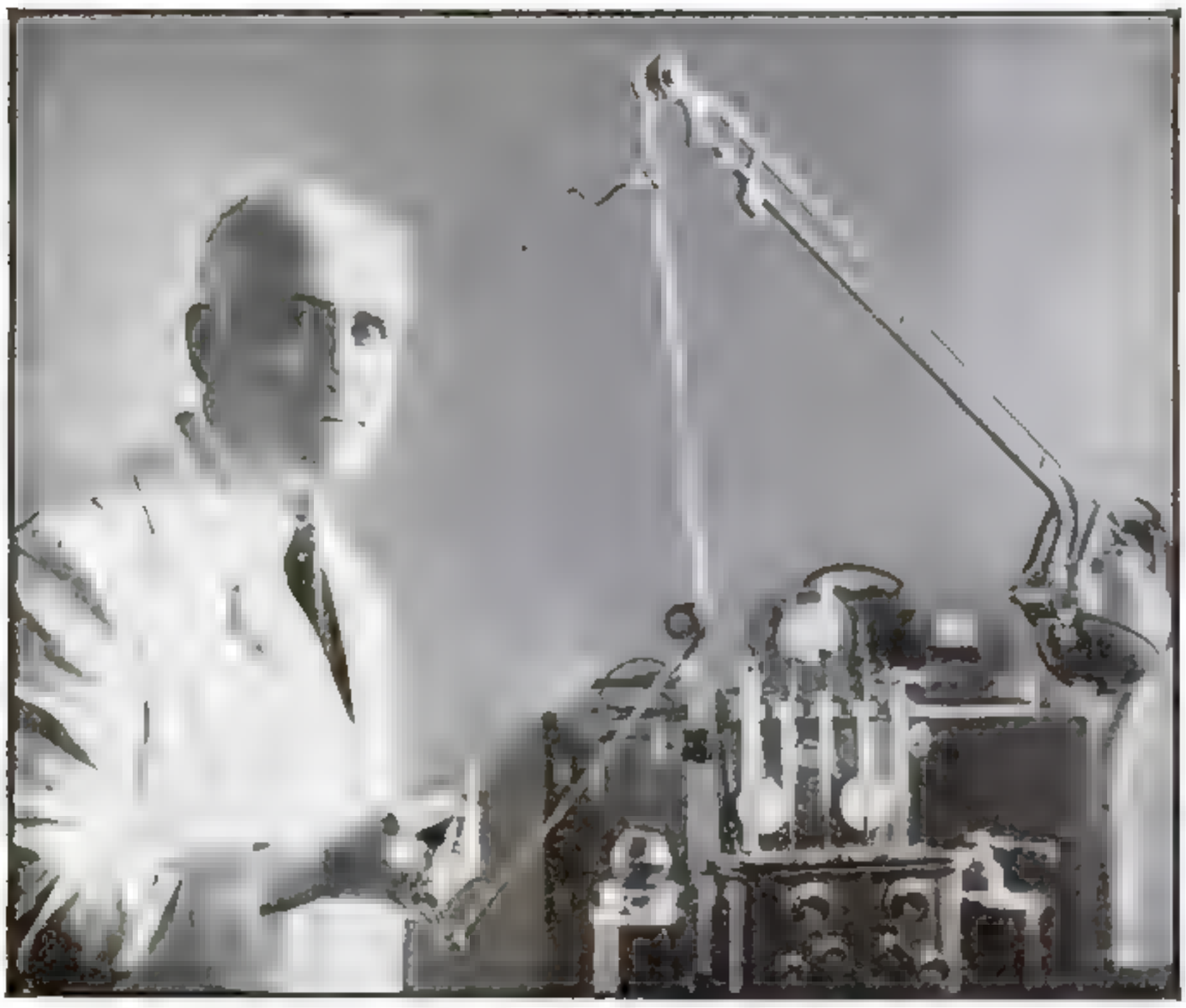
Traveling down Mumbo Creek, the ranger found the fires fresher as he went—proof that the fire bug was working downstream. The ranger took a short cut to where the trail joined the highway, and waited.

Out of the woods soon came a stranger. He professed ignorance of the fires but his shoes matched footprints near the point of origin. The ranger back-tracked with him over Mount Shasta to a camp fire the suspect had left burning, and gathered evidence linking the man to five incendiary fires.

The amazing woodcraft that enabled the Indian to read from footprints even the tribe to which another belonged, has been developed to a science by the use of camera and plaster of Paris. When a telltale track is found, the investigator takes a photograph. *(Continued on page 122)*

Deadens Pain of Dentist's Drill

Amazing New Discovery Ends Years of Search for Easily Applied Anesthetic To Make Painless Dentistry a Reality



Dr Leroy L. Hartman, of Columbia University, whose discovery of a desensitizing substance robs the dentist's drill of its terrors

The cotton is held against the affected part of the tooth for about a minute

To prepare a tooth for treatment, a pellet of cotton is first dipped in the colorless liquid

A TWENTY-YEAR search to find a way of relieving the discomfort of a patient in a dental chair has just ended in success for Dr. Leroy L. Hartman, of the Columbia University School of Dental and Oral Surgery, who announces the discovery of an amazing desensitizer that eliminates pain in the preparation and filling of tooth cavities. Leading authorities hail his achievement as one of the greatest contributions of all time to the practice of dentistry.

While suitable anesthetics have long since been developed for comparatively major dental operations, the prospect of having a tooth filled has remained a bugaboo for the average patient. Until now, no simple anesthetic, easy to apply and wholly devoid of undesirable after effects, has been available for such minor, everyday treatments.

The new desensitizer, a colorless liquid resembling water in appearance, is just such a preparation. Its use requires no injection with a needle, or other elaborate procedure; in fact, a patient need not even be aware that it is being employed. To apply it, a pellet of cotton is simply dipped in the liquid and held against the affected part of the tooth, for a period varying from a minute to a minute and a half.

When this has been done, the tooth is completely insensible to the touch of a dental drill, and remains so for from twenty minutes to an hour. Working without fear of discommoding the patient, a dentist may speedily complete the task of preparing a cavity for filling. So free of discomfort is the process, according to reports, that a trip to the dentist becomes as casual and painless an affair as getting a haircut or a manicure.

Since dentistry began, hundreds of research workers have sought an anesthetic that could be used in this way. Following classical theories of dental pain, they tried all sorts of expedients—forcing pain-deadening substances into the nerves or into the pulp at the center of a tooth to be drilled, or attempting to block the nerve connections to the tooth. After experimenting for years along the same lines, Dr. Hartman abandoned these methods in favor of a new theory that brought success. His research convinced him that it was possible to desensitize the outer portion of a tooth, establishing a localized zone that would act as a barrier to reduce sensations communicated to the sensitive pulp, or inner portion. On the basis of this theory, he developed his desensitizing solution, which takes effect upon the layer of the tooth technically known as the dentine.

To try out the effectiveness of the new solution, and to determine the proper strength to be used, no laboratory animals would serve. Human "guinea pigs" were needed. Volunteers eagerly presented themselves in the clinics of the Columbia Dental School, hopeful of being spared the suffering to which most dental patients of necessity are resigned.

Since last March, Dr. Hartman reports, more than 500 cases have been treated, with results that have vindicated his most optimistic hopes. Difficult cases in the children's clinic, and cases of adults with abnormally sensitive teeth, have proved easy to handle with the aid of the new anesthetic, he declares. Patients have suffered little or no uneasiness in treatments that, under other methods, would have caused almost unbearable pain. Not only does the desensitizer prevent pain, the tests have shown, but it presents the possibility of saving teeth that would otherwise be lost by extraction. Examination has shown that the anesthetic does not in any way impair the vitality of the pulp of the tooth, a drawback to which other drugs have been found subject.

So much importance is attached to the new discovery that it will be safeguarded against possible exploitation by a procedure like that adopted for other history-making contributions to human welfare, including the insulin treatment for diabetes and the ultra-violet irradiation of food. Patent rights for the solution have been assigned by Dr. Hartman to Columbia University, which will control both the quality and price of the solution, and will place the commercial product upon the market. According to the university, the solution will be made available for public use in the near future.

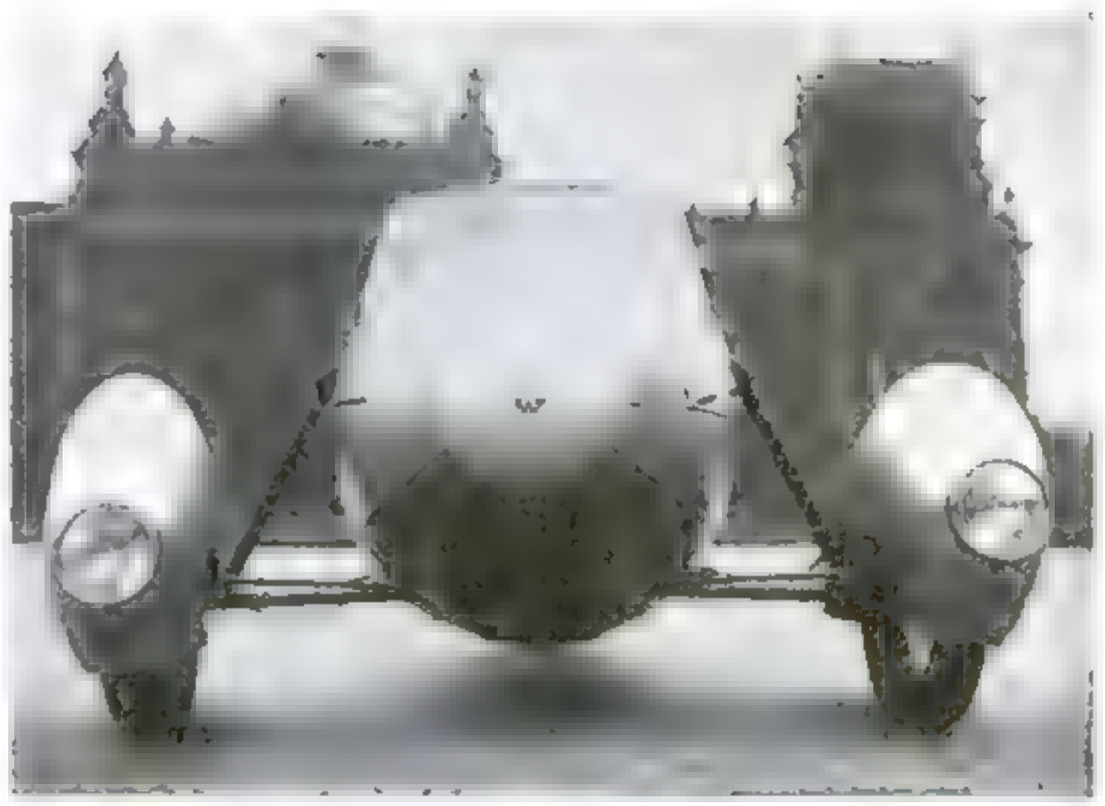
Announcement of the new desensitizer recalls the fact that it was dentistry that first gave anesthetics to the world. Ether anesthesia was first used in the extraction of a tooth, antedating the celebrated occasion when it was first employed for a surgical operation at the Massachusetts General Hospital, Boston, in 1846

MEXICO BUILDS HER OWN "STATUE OF LIBERTY"

LARGER than the Statue of Liberty in New York Harbor is a massive monument recently erected on an island in Lake Patzcuaro, State of Michoacan, Mexico. The upheld right arm is reminiscent of the American Goddess of Liberty, but the striking, angular lines of the Mexican statue are more modernistic in style. The monument is a memorial to José Maria Morelos, a leader in the war by which Mexico won her independence from Spain.

STREAMLINE CAR LOOKS LIKE A PLANE

WITH all wind-resisting body parts cut away, a bullet-nosed, radically streamline automobile has been constructed in Germany. The odd vehicle, shorn of all but its essential elements, bears a striking resemblance to an airplane without wings. It is claimed that the machine will go over sixty-two miles on less than a gallon of gasoline, and can reach speeds as high as seventy miles an hour.



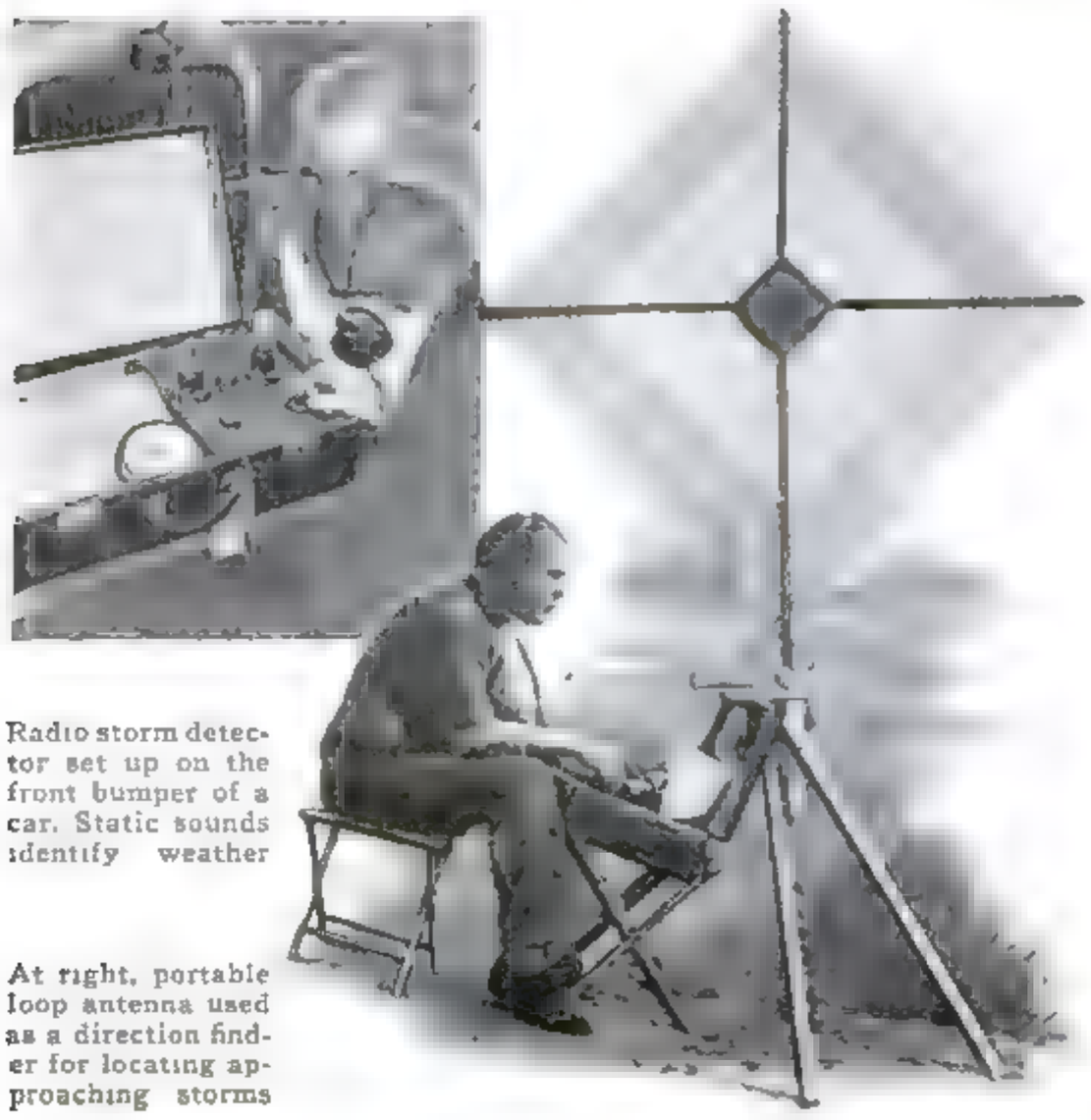
Front view of new German streamline car which resembles a wingless plane

EXCAVATOR DIGS ITS WAY TO A JOB

Steam shovel at bottom of zigzag ramp it dug to reach floor of pit

ONE condition in the recent sale of a new excavating machine to a Birmingham, England, brick-making firm was that it must be delivered ready for work at the bottom of a seventy-foot pit whose sides were nearly perpendicular. No derrick or hoisting appliance was available, so the operator adopted the novel method of making the machine dig its own way down the cliff by constructing the zigzag ramp that is shown at the left.

RADIO DETECTOR FORECASTS STORMS



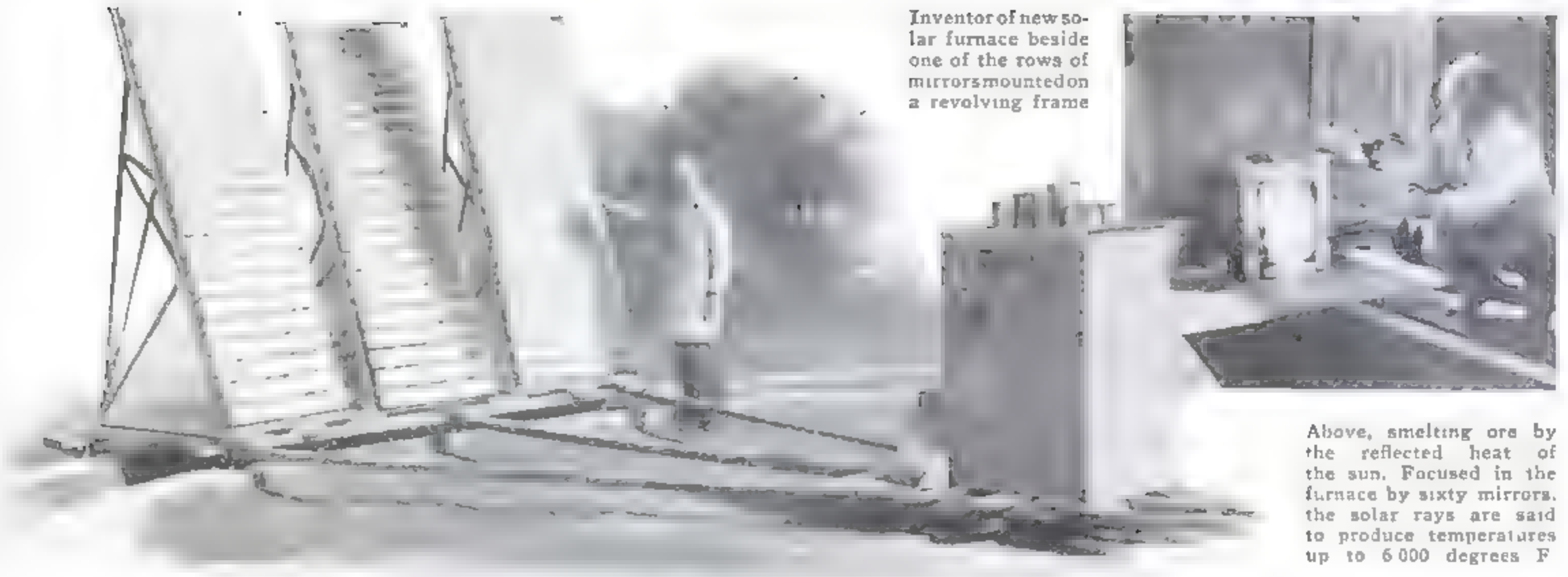
Radio storm detector set up on the front bumper of a car. Static sounds identify weather

At right, portable loop antenna used as a direction finder for locating approaching storms

STATIC may be caused not only by advancing thunderstorms but also by snowstorms, dust whirls, and other types of climatic disturbance, and each type has an individual and distinguishable sound, according to experimenters who have developed what they call a radio storm detector. From hourly bearings taken with this device, they claim, the character, position, path, and speed of any advancing storm may be accurately plotted. Tests now being made suggest that even minor snow flurries and rainstorms may be spotted at distances up to 300 miles.

TINY GLASSES SHIELD EYES FROM GLARE

TO REDUCE the blinding glare of approaching automobile headlights, a novel eye shield has recently been introduced. Strapped to a band worn about the head, a metal frame extends from the forehead and holds two ovals of amber glass in front of the eyes, where they are normally just out of range of direct vision. A slight turn of the head places the glass ovals between the eyes and the rays of oncoming car lights.



Inventor of new solar furnace beside one of the rows of mirrors mounted on a revolving frame

Above, smelting ore by the reflected heat of the sun. Focused in the furnace by sixty mirrors, the solar rays are said to produce temperatures up to 6,000 degrees F.

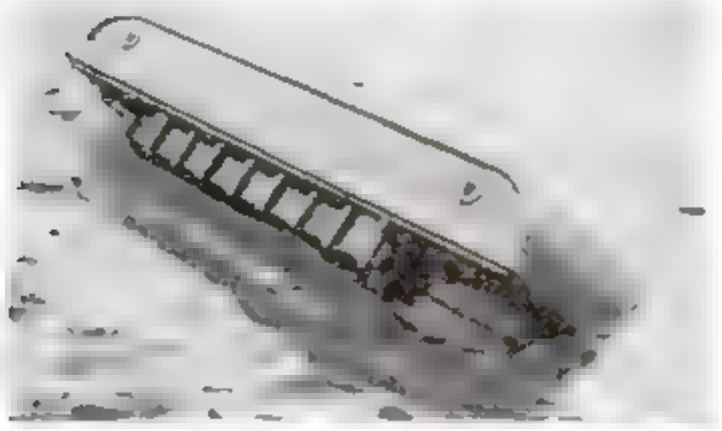
Mirrors Capture Sun's Heat to Smelt Ore

SIXTY mirrors, arranged in three racks that revolve on a circular track, are used in a new type of solar furnace invented by a Californian. When rolled into a position facing the sun, the reflectors focus the sun's rays on the material to be heated in the furnace. Temperatures up to 6,000 degrees F. may be obtained, the inventor declares. It is expected that the apparatus will provide a cheap heat source for a wide variety of uses, including smelting ore and superheating steam. Each additional mirror, it is said, will add 100 degrees F. to the temperature of the furnace. The apparatus is said to be economical in both construction and operation; it can be built for about $1,000, and only one man is required to operate it.

Model of scow loaded and ready to be emptied. Water admitted to compartments overturns it

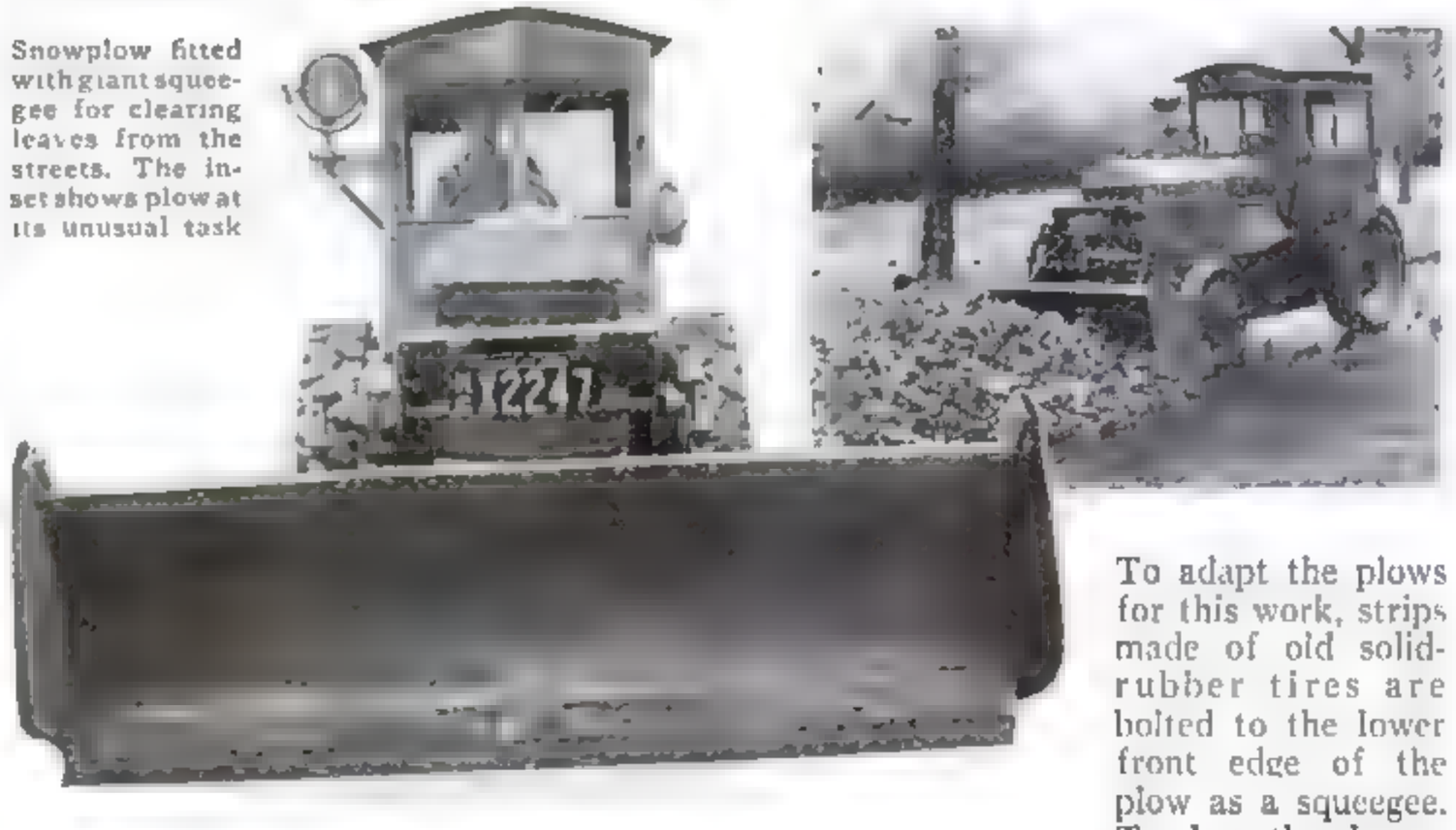
SCOW CAPSIZES ITSELF TO DUMP ITS LOAD

A scow that rolls over to dump its load is a recent invention. A line leading from the towing vessel to the scow operates a hand wheel which allows water to enter an inner compartment, thus destroying the scow's balance and overturning it. When it is emptied, air tanks above the deck ends roll the scow back to normal position and a system of traps empties it of water.



In the upper picture, the scow is turning over to discharge its load. Above, the empty vessel righting itself. A trap system lets out water

VERSATILE SNOWPLOW REMOVES LEAVES



Snowplow fitted with giant squeegee for clearing leaves from the streets. The inset shows plow at its unusual task

MOTORIZED snowplows do double duty at Newark, N. J., where they are used for removing fallen leaves from the streets. To adapt the plows for this work, strips made of old solid-rubber tires are bolted to the lower front edge of the plow as a squeegee. To lay the leaves and ease the rubber edge over the pavement, a sprinkler wets the street in advance of the snowplow.

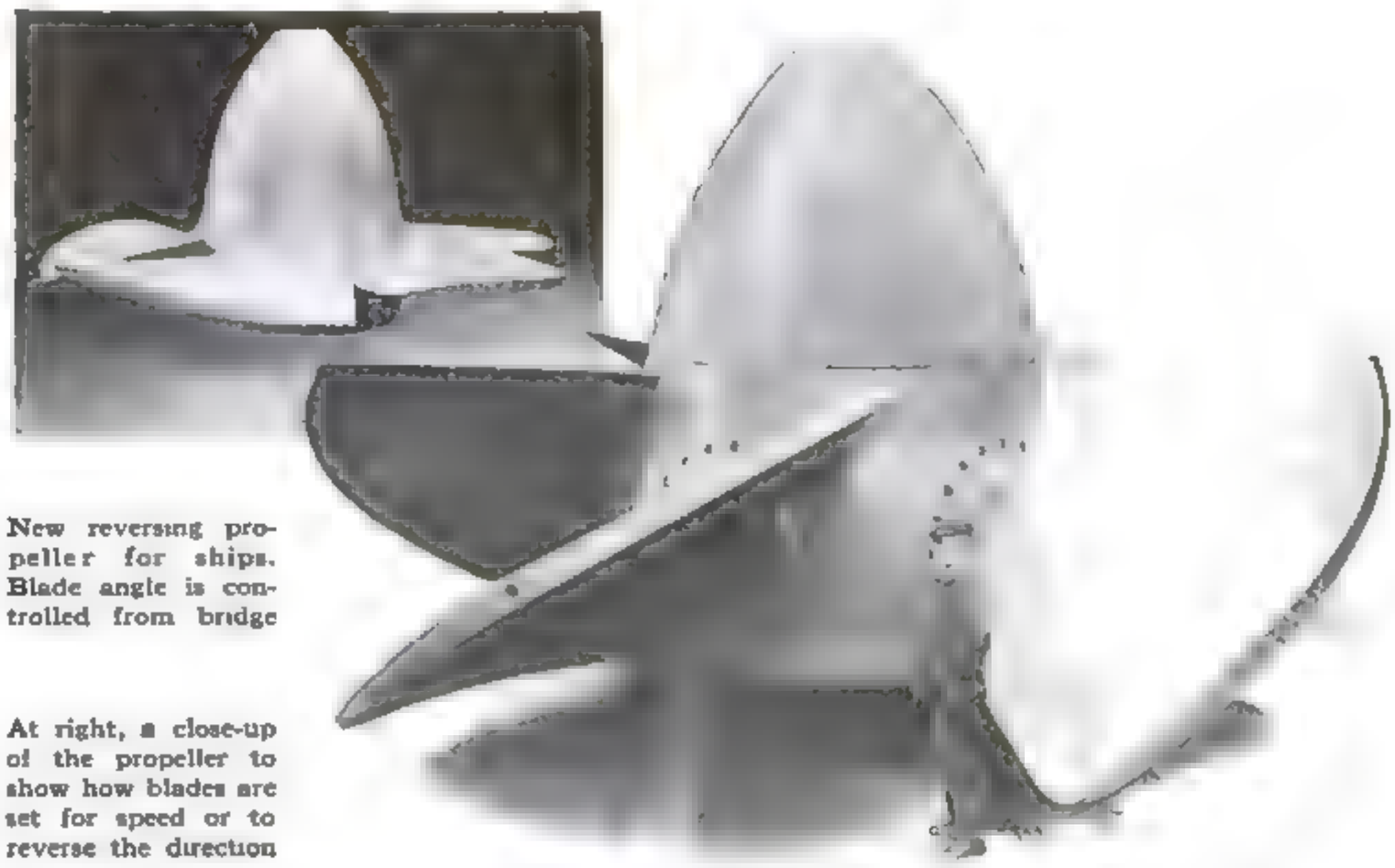
FIREPROOF PLANTS TO GUARD FORESTS

PLANTING belts of fireproof plants is a novel expedient proposed by a western botanist to shield the forests of Southern California from damage by fire. In a recent demonstration before Los Angeles County supervisors, he showed the resistance to flame of bushes that he has developed, by tossing an oil-soaked rag into the midst of one and lighting it. The rag burned to cinders, but the bush was found virtually unscathed. Plants of this kind, he maintains, would provide an effective barrier, wherever they were planted, to the spread of destructive forest fires.

A torch of oil-soaked rags could not set fire to this plant

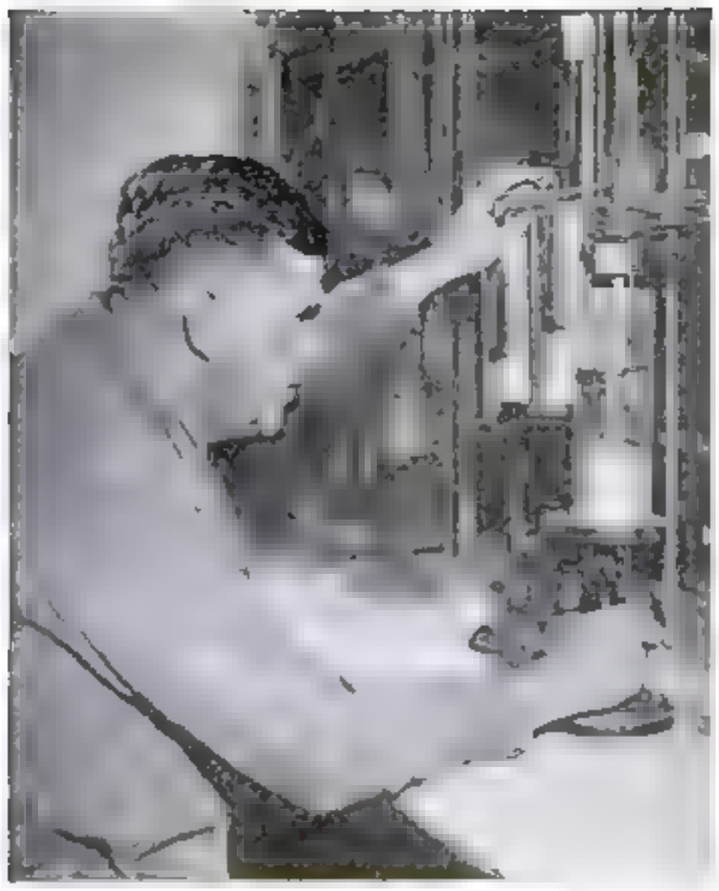
COMPRESSED OIL REVERSES PROPELLER

MARINE PROPELLERS with reversible blades have been perfected, giving ships added maneuverability and greater smoothness of operation. The latest type is controlled hydraulically from the bridge. To alter the course of a vessel from forward to astern, or to change its speed without "jumping," the pilot or helmsman operates a small lever, and oil pressure communicated to a piston within the propeller hub changes the blade setting accordingly. Propellers of this sort are reported particularly advantageous for towboats, since they facilitate smooth and gentle maneuvering to take up the slack in a towing hawser without jerking. Changes of direction are effected much more smoothly than by the common arrangement of reversing gears.



New reversing propeller for ships. Blade angle is controlled from bridge

At right, a close-up of the propeller to show how blades are set for speed or to reverse the direction



Prof. H. S. Booth making "impossible" compounds

MAKES SIX COMPOUNDS OF "INACTIVE" GAS

BY PRODUCING chemical compounds new to science, Prof. Harold S. Booth of Western Reserve University has just upset a teaching of long standing. Chemistry textbooks used by high-school and college students state flatly that the rare gases of the atmosphere—argon, helium, neon, krypton, and xenon—do not combine with any other elements. The very name of argon, a gas used in electric-light bulbs, comes from a Greek word meaning "inactive." Reasoning that unusual conditions of temperature and pressure might alter its behavior, however, Prof. Booth mixed argon with a chemical called boron trifluoride and chilled it to about 200 degrees F. below zero, meanwhile applying pressures ranging from ten to fifty atmospheres. To his delight, he obtained six "impossible" compounds of the supposedly inactive gas.

VALVES CONTROL SPEED OF PARACHUTE'S FALL

SOVIET designers have developed a parachute that allows the user to control the speed of his fall. A hole in the center of the parachute dome may be opened or closed by special valves, accelerating or retarding the speed of the descent.

SKIDPROOF TIRE HAS "SQUEEGEE" TREAD

UNUSUALLY long life is claimed for a "finned" automobile tire just placed on the market. Parallel vanes of flexible rubber, forming the tread, yield to the contour of the road and thus minimize wear. The new style of construction, according to the maker, has also proved unexpectedly effective for preventing skids in turning and stopping, in comparative tests with conventional treads of knobbed or ribbed design. When brakes are applied, the fins of the new tires squirm into a curious serpentine shape that acts as a squeegee and wipes away moisture from a wet pavement, leaving a dry surface that the following part of each tread can grip. On a dry road, the flexing action is said to end skids.

The tire at the left has a new-type tread of parallel vanes of rubber. This arrangement is said to give better brake control

Cross section of tire, and views taken through plate glass to show how tread acts under normal traction load, and in braking

MODELS HISTORIC SHIP IN MODERN MATERIALS

PLASTIC MATERIAL, acetate yarn, and paint thinner were the unusual materials used by a Tennessee model maker to build a ship model of H.M.S. Bounty, a three-masted square rigger. Following designs and plans published in POPULAR SCIENCE MONTHLY, he constructed the hull and masts from a plastic substance used to make inexpensive pocket combs. A cellulose-acetate yarn, employed in weaving wrinkle-proof shirt collars, forms the rigging. All joints and connections are welded together with acetone, a liquid used as a paint remover.

Mercy Flyers Bring

Winging in the Wake of Flood, Storm, and Earthquake, Daring Pilots Rush Food and First Aid

A flying ambulance of the U. S. Army Air Corps. Such craft often give peacetime service by aiding disaster victims

By Robert E. Martin

DISASTER strikes. An earthquake shatters a western city. A hurricane levels a southern town. Roaring flood waters lay waste a thousand farms. Doctors, food, medicine, clothing, are needed by the refugees. So, the Minute Men of the Air, pilots of the Red Cross, take to the sky.

These daring flyers have pulled their ships off fields still rocking in the grip of an earthquake. They have headed out over impassable territory where engine failure meant a certain crash. They have battled fog and gales to carry serum to stricken communities. Their planes, close on the heels of disaster, play a vital part in the relief work of the Red Cross.

A few weeks ago, a West Indian hurricane cut a 150-mile-wide swath across Cuba and headed for the Florida coast. Radio flashed word of the coming whirlwind. Immediately, land planes and flying boats roared away with warning signals. Over isolated villages and small sponge and fishing boats, which carried no radio, they swooped low and dropped floats with white streamers labeled, "Hurricane Warning." Inside the floats, wrapped in waterproof materials, were details of the coming storm. Even before disaster strikes, the disaster pilot starts his work.

In preparation for emergencies, the American Red Cross has worked out an elaborate signal code for use by pilots and ground workers. The airman employs short blasts of his engine for signaling; the ground worker, strips of cloth.

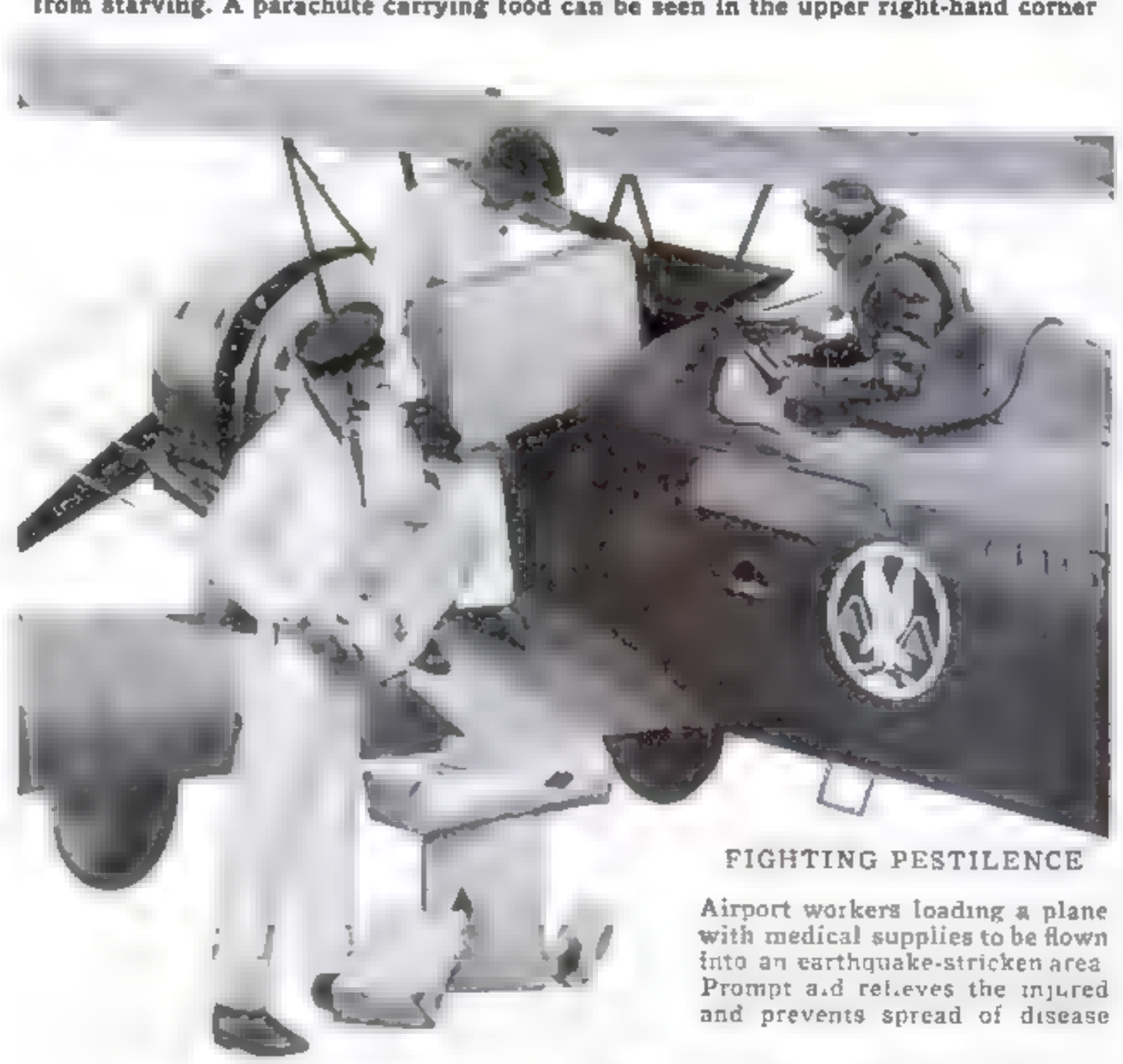
When a pilot gives five blasts of his motor, he is inquiring, "Do you need anything?" Three blasts mean, "Repeat the message; I don't understand it;" two blasts, "Message understood; await our return," and four blasts, "Stand by for a dropped package."

That last signal, a few years ago, ushered in what is probably the most thrill-packed sixty seconds in disaster flying. They occurred as Lieut. Lawrence Genaro and Tom Ryan were preparing to drop food at Claypool Hills, Ind.

It was midwinter. Ice jams in the Wabash River had caused the flooding of more than a million acres in Indiana and Illinois. Twenty-nine thousand persons were victims of the flood and 2,000 were homeless. Eight people lived for nearly a week in a barn surrounded by water; their only food, until planes dropped rations, corn which they crushed into meal and cooked over a fire of cobs. Blizzards and bitter cold turned the flood waters into ice and slush and made rescue by boat impossible.

During the height of the flood, as many as five Army ships at a time were in the air, shuttling back and forth on errands of mercy. Genaro and Ryan had hopped off from the field at Fort Benjamin

When snow marooned a family on this New Jersey farm, Navy bombers kept them from starving. A parachute carrying food can be seen in the upper right-hand corner



FIGHTING PESTILENCE

Airport workers loading a plane with medical supplies to be flown into an earthquake-stricken area. Prompt aid relieves the injured and prevents spread of disease

Rescue from the Sky

Harrison, near Indianapolis, and had headed south. Wrapped in a blanket, they carried a large parcel of food and clothing. Near Claypool Hills, they sighted fifty refugees, marooned on a high spot, waving frantically.

Genaro eased back the throttle and circled lower. At 200 feet, Ryan stood up in the cockpit ready to throw overboard the bundle of supplies. Suddenly, the icy gale from the propeller caught the blanket, whipped it loose, and sent it flapping back over the tail of the plane. Entangled in the control surfaces, the blanket threatened to send the ship crashing to earth. Instantly the pilot saw his danger. He dropped in a fast landing on the only strip of ice available, taking a chance that it would hold. It did. And, after untangling the blanket and unloading the supplies, the two men soared away safely on the return trip to the home airport.

During one disaster in the South, a newspaper printed the complete Red Cross signal code and pilots dropped the papers at all marooned farmhouses. It enabled the victims to signal their needs.

This is done with cloth strips, twelve feet long and two feet wide. White cloth is placed on bare ground, black cloth on snow. In floods, the strips are sometimes floated on the water, supported by boards and sticks. By forming code letters with the strips, a Red Cross worker on the ground can report the number of persons killed and injured as well as the food, clothing, and medical needs of a stricken community.

The symbol for persons killed is A; for those injured, F, and for those homeless, H. By putting Roman numerals before the symbol letters, the number in each case is indicated. Other common needs are signaled as follows: blankets, FN; tents, FT; matches, TT; bacon, AA; beans, AE; powdered milk, AY; drinking water, EK; canned tomatoes, EH. In addition, more than twenty medical supplies, ranging from aspirin, HH, to tetanus antitoxin, NT, are indicated by two-letter symbols. Thus, if a disaster pilot spies the following series of letters laid out on the ground: X FT FN TT EH. he knows the worker below needs tents, blankets, matches, and canned tomatoes sufficient for ten people.

The great Mississippi flood of 1927 was the first American disaster in which planes figured widely. When the swollen river ate its way through levees and inundated 1,250,000 square miles of farming land, Army and Navy planes flew back and forth, reporting the location of victims clinging to roofs and tree tops, while a fleet of 826 boats carried on the work of rescue.

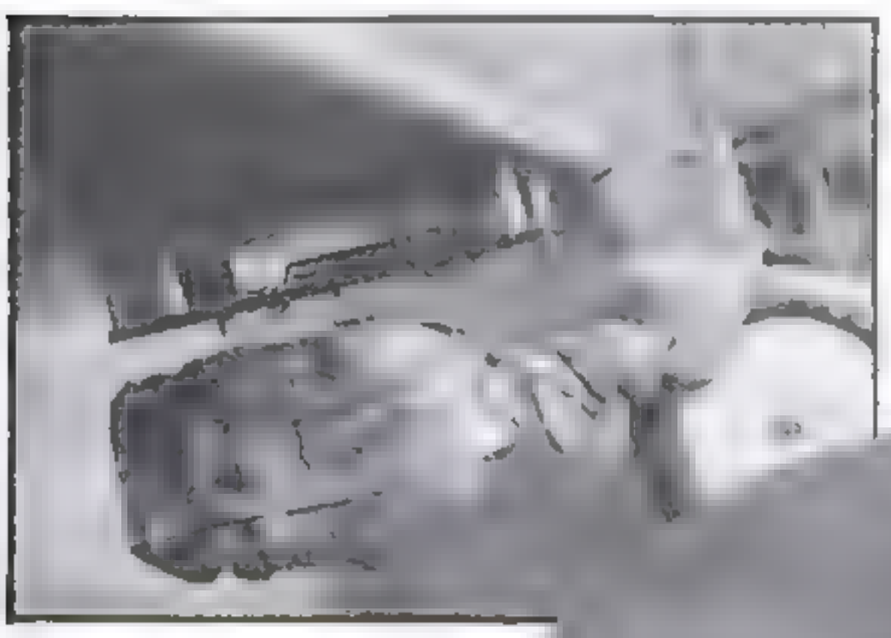
SINCE then, pilots have been the eyes of the Red Cross in every major disaster. Although the organization itself owns no planes, Army, Navy, and National Guard airmen are trained to carry on at a moment's notice.

When the Southern California earthquake of 1933 was wrecking buildings at Long Beach, a pilot hopped off from a field still trembling from the shocks and cruised over the city. Telephone lines were down. Communication was severed between different parts of the city. The pilot's radio report of actual conditions and of points of greatest need proved of immense value in carrying on the rescue work

By flashing a running story of events on the ground below, disaster pilots often aid in rapid-fire rescues. Besides the radio, they use aerial cameras. Photographic records of flood and earthquake areas, on a number of occasions, have helped relief officials to map a program of attack.

In 1929, two dramatic jobs took disaster pilots aloft.

Santo Domingo City, in the Dominican Republic of the West Indies, was virtually wiped out by a fearful hurricane which left 2,000 *(Continued on page 118)*



An outboard motor is the unusual cargo of this bombing plane. Packed in hay and attached to a parachute, it was dropped in a flooded section for use in rescue work. At right, ground-code signals of the type used to convey information to air pilots

The plane at the left is loaded with peace-time bombs containing food. Rescue flyers have developed great skill in dropping such missiles. Above, putting a patient into an air ambulance

By JOHN E. LODGE

Below are shown the largest and smallest of Chinese coins At right, a mold in which Malay "tree money" was cast Coins were broken off as needed

Beads, cowrie shells, and empty cartridges, all used as money in Ethiopia. The Italian invasion doubtless put many more cartridge shells into circulation

Queer Kinds of Money

..FROM ELEPHANT TAILS TO WOODEN NICKELS

Howard D. Gibbs at the safe which houses some of his 130,000 specimens of rare coins and curious forms of money

NOT long ago, a bank clerk in a midwestern city was running over coins that had been deposited during the day. A discolored one-cent piece caught his eye. Closer inspection revealed that it was a rare "strawberry-sprig" penny, minted in 1793. Its worth, as a collector's item, was $300—30,000 times its face value!

A depositor in another bank recently brought in one of the first silver dollars ever minted in the United States. By putting hoarded money into circulation, the depression brought to light rare and curious coins, aiding collectors who ride the hobby of numismatics.

More than 5,000 people, in the United States alone, collect old coins and queer money. Their hundreds of thousands of specimens give fascinating side lights on customs, laws, and ideas of the past and trace the story of money through its varied and successive chapters.

In such collections, you find stone doughnuts, metal bells, humming-bird feathers, blocks of salt, fishhooks, elephant tails—strange moneys of the past, crude predecessors of our modern coins and bills.

One of the largest private collections of unusual money in the world has been assembled by Howard D. Gibbs, of Pittsburgh, Pa. In his home museum, Gibbs has 130,000 specimens.

It was a small French coin that first interested Gibbs in collecting unusual moneys. He was seven years old when a relative gave him a coin dated 1656. It still has a place in his world-famous collection, a collection that now occupies a huge safe, fills a large closet, and overflows into scores of boxes and containers.

A day spent in his home museum is like a Marco Polo journey through strange realms of money. You see "pieces of eight" of the Spanish Main, spade coins of ancient China, money dating from the time of Haroun-al-Raschid, the Caliph of Bagdad. You handle a piece of money that looks like a hat, one that looks like a saddle, another that looks like the tongue of a tiger. You see coins of the Bible—shekels used by the money changers, pieces of silver such as Judas took, tribute pennies, and the "widow's mite." There are Baluba crosses from the Belgian Congo, tea bricks from Burma, bread money from Russia, cheese money from China, cacao beans from the days of Montezuma.

In a great coil, there are 10,000 tiny, crimson humming-bird feathers sewed to a belt of braided material. At Vanikoro Island, in the South Seas, this feather money once was standard currency. Similarly, in Mexico, at the time of Cortez's invasion, tail feathers from the brilliant quetzal bird symbolized wealth in the royal family. And, among tribes of North American Indians, in the early days, scalps of red-headed woodpeckers passed as money, a scalp being equivalent to about fifty cents.

"Here," Gibbs tells you, "is the largest metal coin in the world."

Made of Alaskan copper, it is half as tall as a man and weighs ninety pounds. Such giant coins were used in the northern country 100 years ago and were worth 5,000 blankets or $2,500. The smallest coin in the collection is an Oriental piece hardly as large as a bird shot.

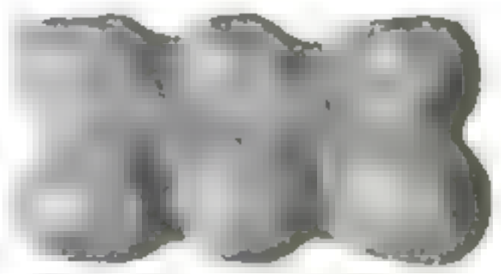
In the primitive days of wandering tribes, Gibbs explained to me, there was little need for any form of money. If one

A Baluba cross, used in the Belgian Congo 200 years ago. It was made by digging a trench and pouring in molten native copper

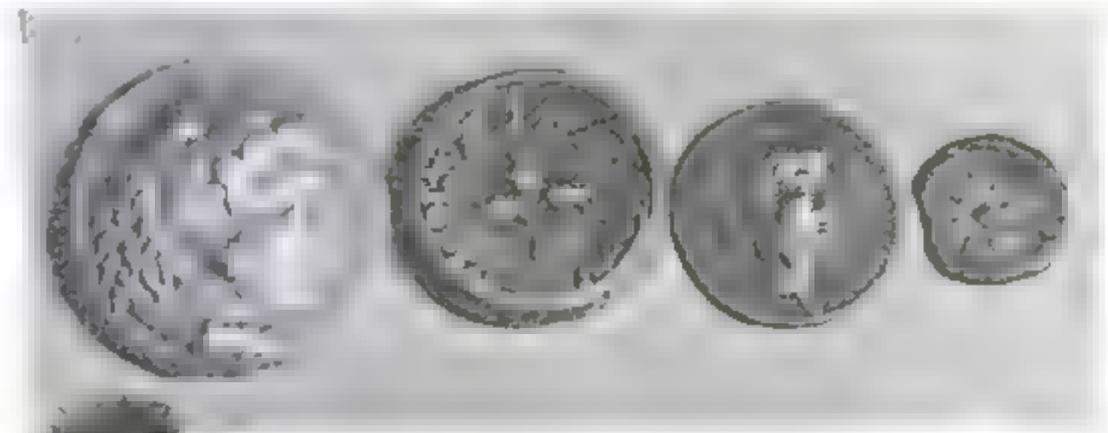
Elephant-tail hairs, like those shown at the left, were legal tender in Central Africa until modern firearms caused inflation

Gibbs displays the largest metal money known. Used by natives of Alaska a century ago, it is made of copper and was worth $2,500

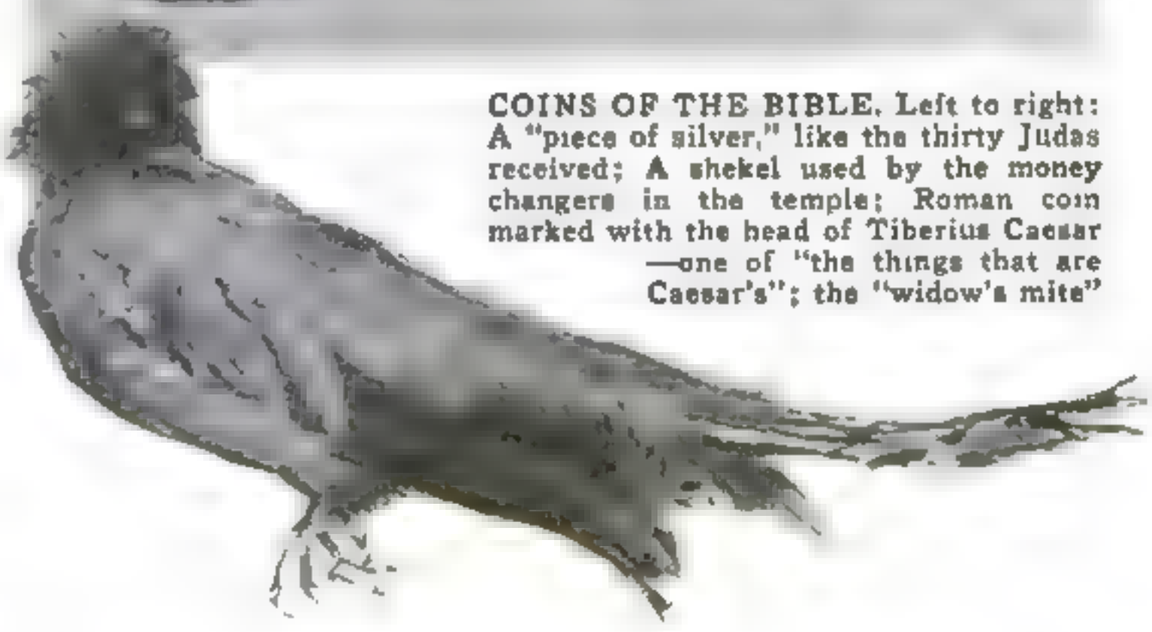
Teeth of dogs and boars, a medium of exchange in New Guinea. Traders made counterfeits



SALT MONEY. Ethiopians "salt down" fortunes in this form. Beggars are given a lick



COINS OF THE BIBLE. Left to right: A "piece of silver," like the thirty Judas received; A shekel used by the money changers in the temple; Roman coin marked with the head of Tiberius Caesar —one of "the things that are Caesar's"; the "widow's mite"



Feathers of the quetzal symbolized wealth among the Aztecs

man had a cow and wanted a tent and another had a tent and needed a cow, they traded possessions. But as people settled down and markets sprang up, some yardstick or standard of value became necessary.

The first standards of value were grain and cattle. In various parts of the world, salt, dates, cocoa, olive oil, tea, coal, leather, rubber, and porcelain became the yardsticks. At one time, cowrie shells were current as money all over the Orient and the coast towns of Africa. Copper pots were exchanged as money on the Island of Cyprus. And, in America, tobacco in the South, and beaver skins in the North passed as currency in pioneer days. Contracts in Colonial Massachusetts were made payable in silver, beaver skins, or wampum. The latter, produced from periwinkle shells, was standard currency among the Indians and was accepted in payment of fares on New York ferries up to the end of the seventeenth century.

When you reach into your pocket for change, you can be thankful you do not live on the Island of Yap. For generations, huge pieces of stone money were employed by natives of this island in the South Seas. Gibbs showed me a typical specimen. Shaped like a doughnut, it was carried about by inserting a stick in a hole in the center. A stone coin thirty inches in diameter and weighing 170 pounds had a value of a canoe, a wife, or 10,000 coconuts.

The quarries from which the stone money came lay on another island 300 miles away across a treacherous sea. One characteristic of a primitive money, as Gibbs pointed out, is that it was usually something difficult to obtain. Thus, whale teeth formed currency in the Fiji Islands, a tooth having a trading value of $150. Boar tusks passed as money in Papua and, in Central Africa, the black, wirelike hairs in an elephant's tail were widely used before the days of firearms. After white hunters invaded the Congo, killing large numbers of the animals, there was an inflation in elephant-tail money and the value of the hairs dropped.

By examining the coins of a distant land, Gibbs told me, you can oftentimes tell much about the sort of clothes the people wear. In New Guinea, for example, the money, even today, contains a hole. Wearing scant clothing, the natives have no pockets and keep their wealth on strings around their necks. In Malacca, in the Malay Peninsula, coins were cast in metal "trees." A dozen coins branched from the central stem, like apples. When a native made a purchase, he broke off a coin; when all the money was gone, he threw away the stem that remained.

In Kurdistan, money took the form of gold and silver arm bands. When a village was attacked, the natives slipped their money on their arms so they could take their wealth away if forced to flee. In addition, the metal bands protected their arms against swords and knives.

A few years ago, Gibbs discovered three of these rare "coins" in a Chicago pawnshop. They had come from the estate of a local collector. The pawnbroker had no idea what the trinkets were and parted with all three for twelve dollars. Later, Gibbs sold one for $125.

Gumdrops were recognized as money at one time in Alaska. Shortly after traders opened up the territory, natives used the candy as coins. During the construction of pioneer railroads in the West, whisky was a commodity currency. Contracts with workmen called for payment in so much money and so much whisky a day.

Gibbs showed me a curious piece of metal, shaped like a spade or the head of a spear.

"That," he said, "is the oldest metal money in the world. It was used in ancient China. For more than thirty centuries, it has been in the world, passing from hand to hand and from generation to generation. What a story it could tell!"

This coin illustrates one way money developed. First, the Chinese left their weapons or tools as surety for debts. Then, they fashioned small imitation weapons or tools and left them as tokens, retaining the use of the real implements. Another early coin, dating from about 700 B.C., shows the same evolution. It is a small metal reproduction of a bolt of cloth. First, the actual silk *(Continued on page 123)*

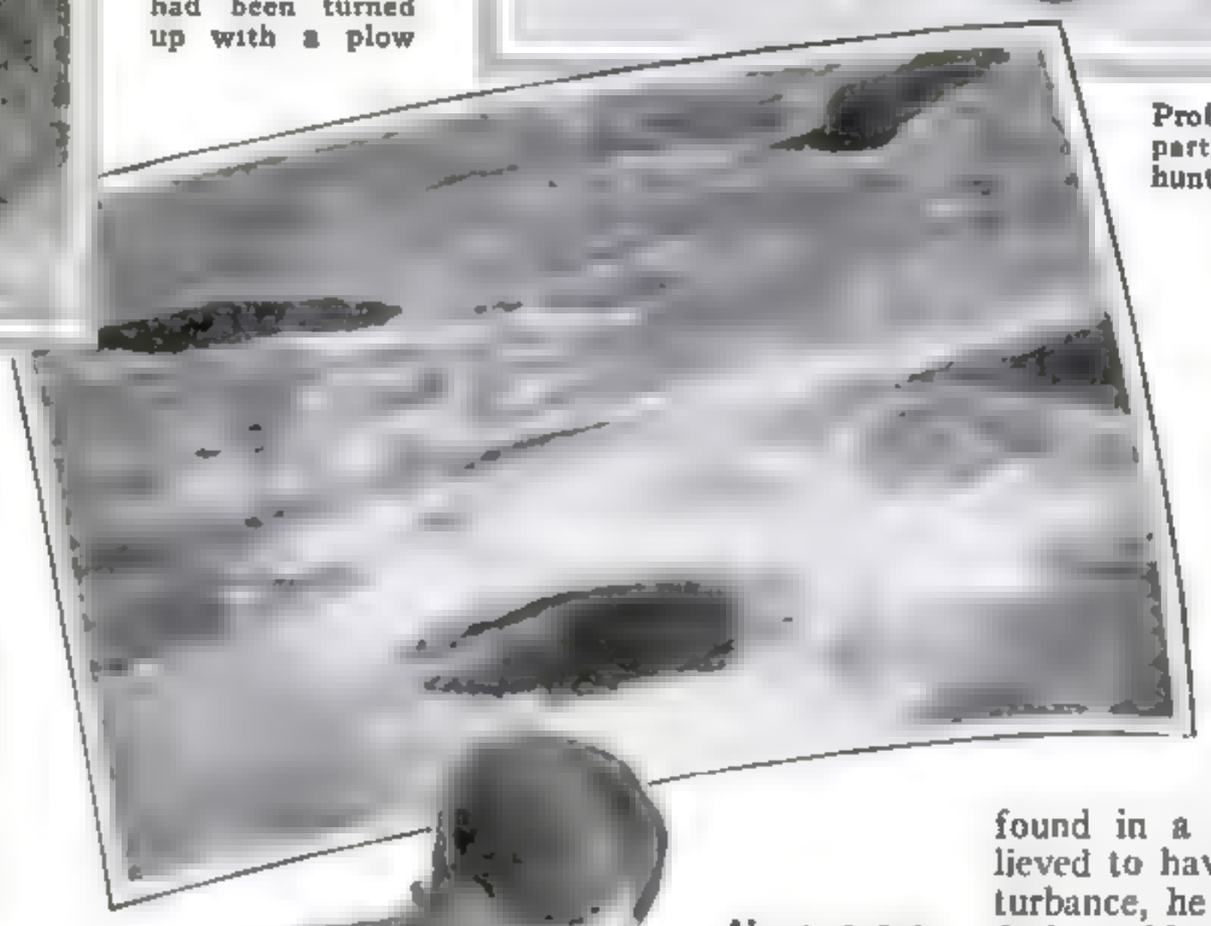
Hunting Meteorites

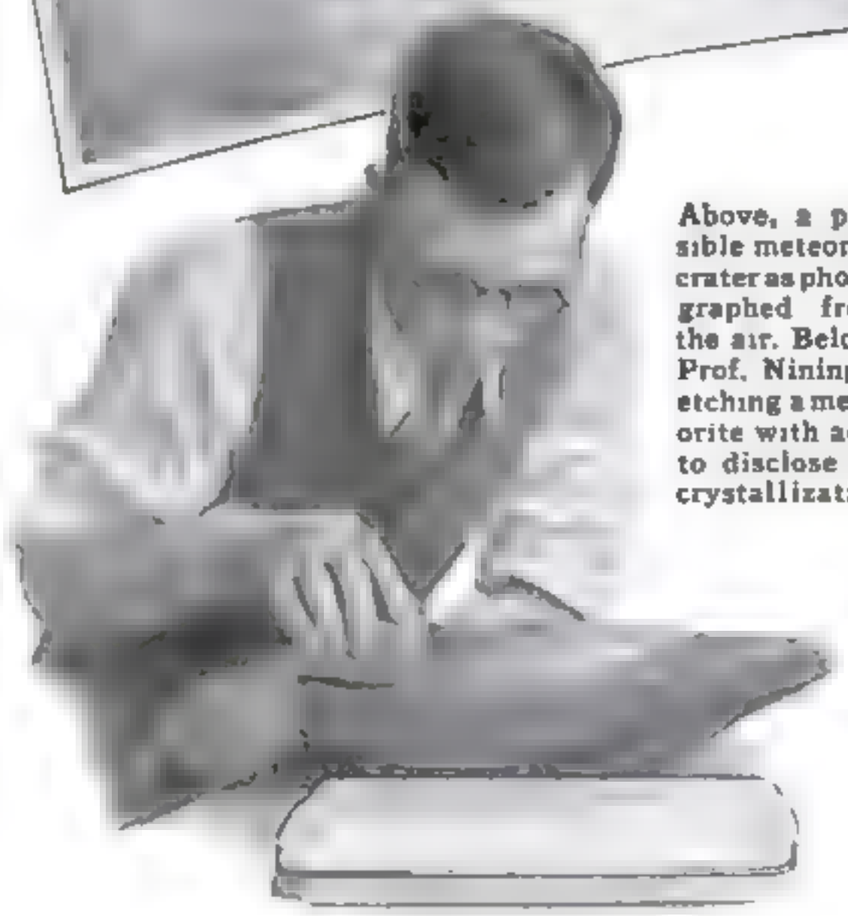
with an AERIAL CAMERA

Prof. Nininger, at right, with the party he led on the first airplane hunt for unknown meteorite craters

AN AMATEUR MAKES A FIND

J. B. Lynch with the 749-pound Hugoton meteorite found at Hugoton, Kans. Lynch, a high-school student, showed Prof. H. H. Nininger the spot where a fragment of the stone had been turned up with a plow





Above, a possible meteorite crater as photographed from the air. Below, Prof. Nininger etching a meteorite with acid to disclose its crystallization

SOARING over the sparsely settled plains of the Southwest, a cabin monoplane recently carried a party on a novel hunting trip. Armed with an aerial camera, they were tracking meteorites—masses of mineral matter that have whizzed out of interplanetary space and buried themselves in the earth.

Hunting meteorites from the air is the latest wrinkle to be employed by Prof. H. H. Nininger, who has made the finding and study of these celestial visitors his life work. On his recent expedition, he made a 2,000-mile circuit over parts of Colorado, New Mexico, and Texas. This area was selected for the search because it is largely uncultivated, and the craters formed there by falling meteorites would be found undisturbed except by surface erosion.

So-called "buffalo wallows," and prairie lakes that looked to Nininger as though they might cover meteorite craters, were photographed and their locations were noted. In Texas, the party flew over a known meteorite crater and made pictures for comparison. When he returned to his starting point at Denver, Colo., the scientist had pictures of scores of places that he considers worth searching; it now remains to investigate these suspected craters on the ground.

Nininger was the first scientist ever to make a deliberate and systematic search for meteorites. While others contented themselves with finding and examining specimens that had been seen to fall, he recruited an army of volunteer searchers in every state of the Union by delivering lectures to groups of farmers, showing them specimens of meteorites, and offering hard cash for any that might be turned up by the plow. Where other investigators acquired two or three meteorites in the course of a year—mainly by accident — Nininger has collected them by the thousands.

When a great meteorite fell near Paragould, Ark., a few years ago, Nininger questioned hundreds of persons who had witnessed the terrifying sight. Although an eighty-five-pound fragment found in a farmyard was generally believed to have been the cause of the disturbance, he was convinced that a larger find would reward searchers. Drawing a line on a map, he directed farmers to follow it for several miles from the point where the fragment had landed. Just three miles away, buried under nine feet of soil, they discovered the 800-pound Paragould, largest stony meteorite known.

Only slightly smaller is the Hugoton, which Nininger found as the result of one of his lectures. At the end of a talk at Hugoton, Kans., J. B. Lynch, a high-school boy, recalled that he and his father had plowed up a stone that looked like the specimens the lecturer had exhibited. "It's still out in the field," he said, "if you want to come and see it." The "stone" proved to be a fifteen-pound fragment sheared off a larger mass. By digging where it had been turned up, Nininger uncovered the 749-pound monster.

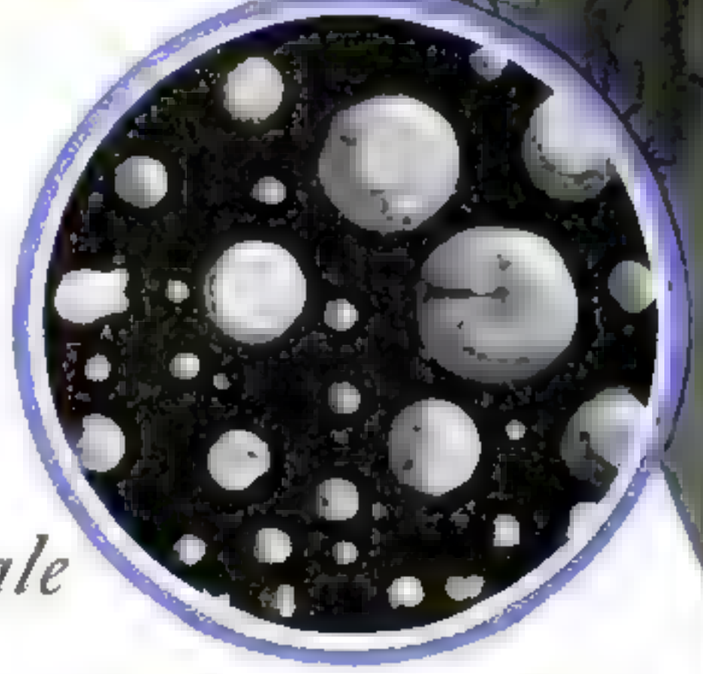
Lynch is not the first farm boy to earn a part of the cost of his education by the chance turn of a plowshare. Nininger pays a dollar a pound for small meteorites, and hundreds of dollars for the larger ones.

Now that he has enlisted the aid of the airplane in his search, he expects to unearth many unsuspected meteorites, which may add to our knowledge of the universe beyond the earth's atmosphere.

FIFTY YEARS OF *Aluminum*

HE PUT A "PRECIOUS METAL" IN KITCHENS

Charles Martin Hall, whose discovery of the electrolytic process for producing aluminum made the metal available for commercial use. In circle, first specimens he made



The Strange Story OF THE Magic Metal

By *Edwin Teale*

JUST half a century ago, the commonest metal in the earth's crust was as scarce as silver. Prof. Frank F. Jewett, of Oberlin College, Oberlin, Ohio, was pointing out this curious paradox to his chemistry class in the spring of 1883.

"If any of you can extract aluminum in commercial quantities," he concluded with a smile, "you are sure of a fortune"

A slender student in one of the front rows nudged his neighbor. "I'm going after that metal!" he whispered

That was the beginning of one of the most dramatic achievements in chemical research. The student was Charles Martin Hall. Hardly three years later, in a wood-shed workshop, using makeshift apparatus and homemade batteries, he achieved the goal which the greatest scientists in the world had failed to attain.

On February 23, 1886, Hall rushed into Jewett's laboratory with a few small buttons of silvery metal in his hand. It was the first aluminum produced by the method which now turns out the world's supply of more than 375,000,000 pounds a year

Those buttons are still in existence. So fast has the world of aluminum moved, that few of the millions who take this metal for granted know its amazing history. Few realize that less than a century ago, platinum and aluminum jewelry sold for exactly the same price; that, at the Paris Exposition of 1855, a lump of aluminum occupied a place of honor next to the crown jewels; that in 1884, when the 100-ounce aluminum cap was cast for the Washington Monument, it was exhibited in the window of a Fifth Avenue jeweler, in New York City.

A side post for use in railroad rolling-stock construction being extruded at a mill. The silvery metal is used in high-speed trains

upon the unique combination of qualities found in this magic metal.

So many, so varied, so vital are the uses of aluminum that it is easy to forget that people still living have seen virtually its whole commercial history. It is easy to forget that only 111 years ago, no one in the world had ever seen aluminum.

The first man to set eyes upon the metal was the Danish experimenter, Hans Christian Oersted. In 1825, Oersted, by chemical methods, obtained small globules of aluminum no larger than a pinhead. Later, the German chemist, Friedrich Wohler, accomplished the same feat. But it was not until Napoleon III became interested in using the light metal for military helmets that Henri Sainte-Claire Deville was set to work producing usable quantities of aluminum. His chemical reduction method put the metal on the market, but large quantities and cheap production were impossible.

At this point, encouraged by Prof. Jewett, Charles Martin Hall started his quest. Every spare minute went into his search for a short cut to the production of aluminum. After he graduated, he continued his researches, making his own batteries and assembling makeshift ap-

The Navy and Marine Memorial at Washington, D. C., cast from aluminum—an example of the use of the lightweight metal in the arts. At right, an open-pit bauxite mine in Arkansas

Napoleon III entertained guests at a table set with aluminum forks. The King of Siam wore an aluminum watch fob. And, when the Prince Imperial of France was one year old, a minister of state bought him the rarest thing he could find, an aluminum rattle. In 1852, the metal was quoted at $545 a pound; today, it sells for about twenty cents a pound. The discovery made by the twenty-two-year-old student at Oberlin College is responsible. As it celebrates, this month, the fiftieth anniversary of his accomplishment, the world is depending in countless ways upon the metal he made commercially available.

From the time you wake up and squeeze tooth paste from an aluminum tube in the morning, until you go to bed at night, you meet the silvery metal in a host of forms. Products range from rivets the size of a match head to fifty-ton cranes and giant Zeppelins. Racing yachts, chewing-gum wrappers, chairs, wheelbarrows, Hollywood armor, baby cradles, tank cars, horseshoes, beer kegs, bicycles, fishing reels, and tiger cages all have been made of aluminum. It is used in gleaming church spires, roaring airplanes, 100-mile-an-hour streamline trains. Engineers on the Mississippi use aluminum booms and buckets; workmen at Boulder Dam employ dump trucks with aluminum bodies. T.N.T. is mixed in aluminum vats. Snowshoes, whistling teakettles, golf clubs, and fireworks all depend

At left, a workman is welding side pieces onto a spun shell to form a large utensil. Below, rebuilding a bridge with aluminum to save 750 tons of weight. Note how easily the laborer in the foreground is carrying a long channel

paratus in a shed back of his home.

Aluminum oxide, or alumina, was comparatively easy to obtain. It was reducing the oxide to the metal that had balked previous efforts to produce aluminum in commercial quantities. Hall sought to reach the goal by a new road—electrolysis, or the chemical decomposition of the alumina, while in the molten state, by an electric current. The melting point of alumina is 2,050 degrees C., far too high for Hall's home-made bellows and furnace. So he sought a chemical salt which when molten would dissolve alumina and enable him to electrolyze it in solution.

Women's accessories of aluminum

First he tried fluor spar. It proved unsatisfactory. Then he turned to magnesium fluoride. Again, the result was failure. Finally, he tried cryolite, a glassy substance brought from Greenland. Pumping the bellows in his shed laboratory, Hall melted the cryolite and sprinkled into it the snow-white, powdered alumina. Then, for two hours, he let an electric current pass through the seething mass. In the bottom of the crucible, when the test was ended, he found small globules of silvery metal. As soon as they were cool, he rushed out into the cold February day to show Prof. Jewett that his search had reached its goal.

Curiously enough, 3,000 miles away at Gentilly, France, another young experimenter of Hall's age had made the same discovery at almost the same time. He was Paul Heroult. Inheriting a small tannery, Heroult used the Gramme dynamo in it to provide electricity for his tests. The lives of these two workers ran strangely paraliel. They both were born in 1863. They both made their discovery in 1886. And they both died in the same year, 1914. Hall's success preceded Heroult's by a scant two months.

Theoretically, every clay bank is an aluminum mine. In practice, however, an ore, named bauxite, after the French village of Les Baux where it was first discovered, is employed in the production of aluminum. Most of the bauxite used in America comes from Arkansas and from Dutch Guiana. It first goes to a vast plant at East St. Louis, Ill., where the alumina is extracted. This white powder is shipped to refining centers in New York State, North Carolina, and Tennessee. Out of the electrolytic baths comes the pure aluminum. Approximately two pounds of alumina is required to produce one pound of metal. The electricity needed to produce that pound of aluminum would keep a forty-watt lamp burning continuously for twelve and a half days.

In place of Greenland cryolite, a synthetic cryolite is now widely used at refining centers.

The first plant that employed Hall's cryolite method went into operation on Thanksgiving Day, 1888, at Pittsburgh, Pa. From it has grown the gigantic, sprawling battery of factories along the Allegheny River at "the aluminum city," New Kensington, Pa.

As you go through these acres of buildings, you see electric furnaces towering forty feet in the air; steam chambers and gas-heated ovens aging alloys; great rollers reducing slabs of aluminum to silver-colored foil, .00035 of an inch thick. Rows of extrusion presses, fed billets of hot aluminum as a cannon is fed shells, force out streaming pipes and tubes. In fascinating, twenty-four-hour-a-day activity, the machines are transforming tons of the metal which Hall made plentiful into articles of utility and beauty.

In fact, the use of aluminum has spread too rapidly for our vocabularies to keep step. We still call aluminum containers "tin cans"; we still refer to aluminum waffle molds as waffle "irons"; we still speak of "tin foil," although most of it is made of aluminum.

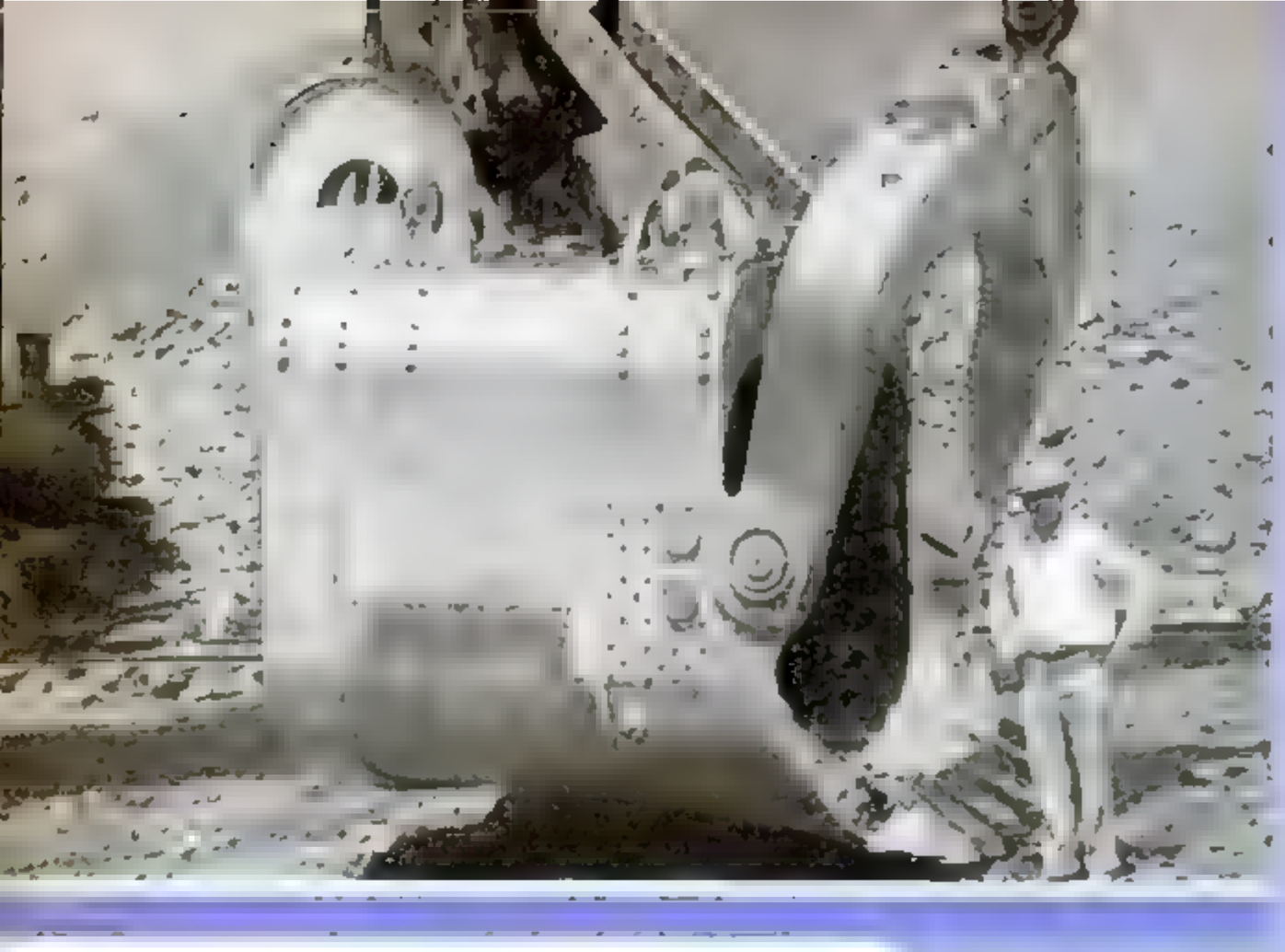
Probably the first commercial use of the lightweight metal in this country occurred in 1876 when a New York concern produced a surveyor's transit made of aluminum. The transit was in constant use until 1909, when, still in good condition, it was placed in a museum.

Watch fobs formed one of the early products turned out after the Hall process went into operation. Then came cooking utensils. So rapidly has this field expanded that more than 350,000,000 aluminum pots and pans have been made in the United States alone. One queer demand for aluminum came in 1906 when Walter Wellman, the arctic explorer, was grooming a dirigible for a flight to the North Pole. He had special aluminum boats shipped to Spitsbergen to carry on his airship for emergency use.

This machine rolls aluminum sheet into foil. Much of the wrapping material commonly called "tin foil" is aluminum

Below, at left, beer barrels made of the magic metal. No lining is required for them. At right, aluminum bassinets provided for new-born babies at a hospital

A workman applying aluminum foil as an insulating material. Crumpled and arranged in multiple layers, it holds heat



This huge aluminum shovel dipper takes up sixteen cubic yards of dirt

Trouble at the Chicago stockyards, in 1897, gave aluminum another chance to demonstrate its value in an entirely new field. Locomotive gases at the yards corroded the copper telephone wires and produced frequent trouble at the switchboard. As an experiment, half a mile of aluminum wire was installed. It proved so satisfactory that its use spread. Today, there are more than 430,000 miles of aluminum cable in use, and a large part of the high-tension power lines of the country are formed of aluminum cables with steel cores added to increase their strength.

Every year, millions of pounds of metal are reduced to a flaky powder to provide the pigment for aluminum paint. Twenty-seven states require it to be used on bridges and highways. Ships employ it as a weight saver. Tests have shown it has remarkable power to protect wood from moisture and ultra-violet rays.

Laboratory tests at New Kensington revealed the secret of this power. When the paint is made, the metal particles are placed in a varnish base, about two pounds of aluminum in a gallon of the vehicle. Before the paint dries, the experimenters found, some of the little flakes of aluminum rise to the top and "leaf," or overlap like shingles. The result is a thin skin of metal which protects the surface from sunlight and moisture.

To aid in discovering new uses for aluminum as well as to learn new facts about its remarkable properties, about 100 scientists and technologists work in the huge, hilltop laboratory at New Kensington. During a recent visit to "the aluminum city," I watched these men at work. A host of ingenious machines aids them. In one room, long rows of humming electric motors are pushing, pulling, twisting, vibrating tiny pieces of aluminum. Day after day, week after week, month after month, and even year after year, the punishment continues. By such fatigue tests, the scientists are learning more and more about aluminum and its alloys. As many as 40,000 specimens of aluminum are tested for tensile strength in a single year.

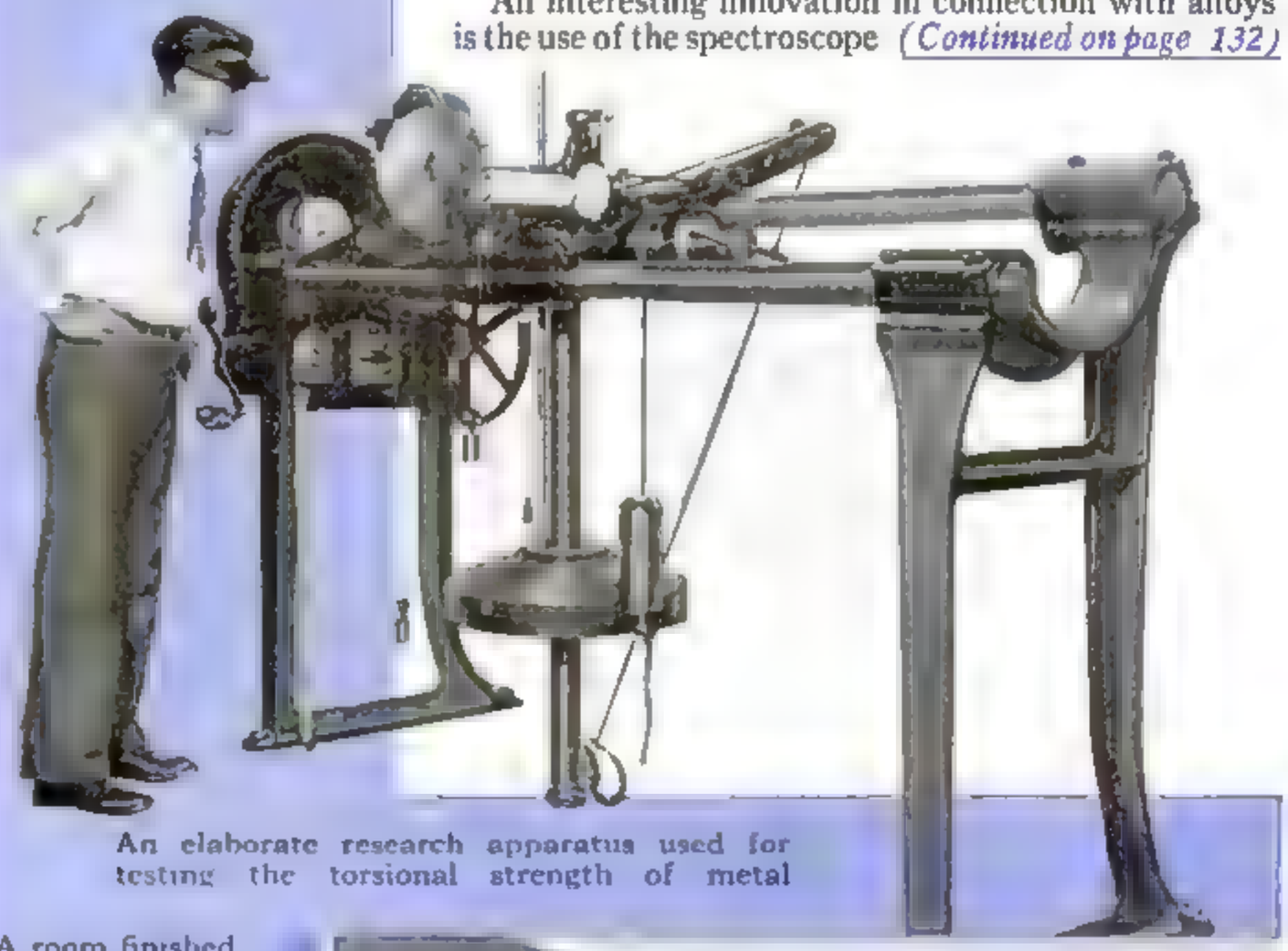
One electric mechanism pushes and pulls on a strip of aluminum 1,800 times a minute, thirty times every second, day and night, until the metal breaks. Another reproduces the vibration of an airplane, and a third measures the "creep," or elongation of the metal at high temperatures. Testing machines having screw threads made with watchmakers' precision, can exert a pressure of 330,000 pounds.

Thirty thermocouples, as fine as the threads of a spider's web, measure the heat radiated by aluminum and alloys. Salt-spray tests, which continue for years, reveal new facts about corrosion. And, an intricate laboratory mechanism constantly subjects aluminum specimens to load strains while an electric current passes through them. Humming, spinning, pounding, the research machines are always at work. So new is aluminum that the research men are still exploring its properties and possibilities.

Besides general research, the laboratory tackles thousands of specific problems. A shaving-cream manufacturer wants to put his product in aluminum tubes. Will the cream corrode the metal? A manufacturer wants a container in which to ship a specific chemical. Is aluminum suitable? A packer desires to put sardines in aluminum cans. Will the metal keep the fish in good condition? In each case, only the laboratory can tell. Technologists set to work, make their tests, and give their report.

Right now, they are grappling with the problem of producing alloys which will have greater strength at higher temperatures. This will facilitate the work of aircraft engineers in designing engines with more power per pound of weight. How much weight can be saved by substituting aluminum for steel wherever possible, was recently demonstrated when an aluminum Pullman car took to the rails. It weighed only half as much as the conventional sleeper.

An interesting innovation in connection with alloys is the use of the spectroscope *(Continued on page 132)*

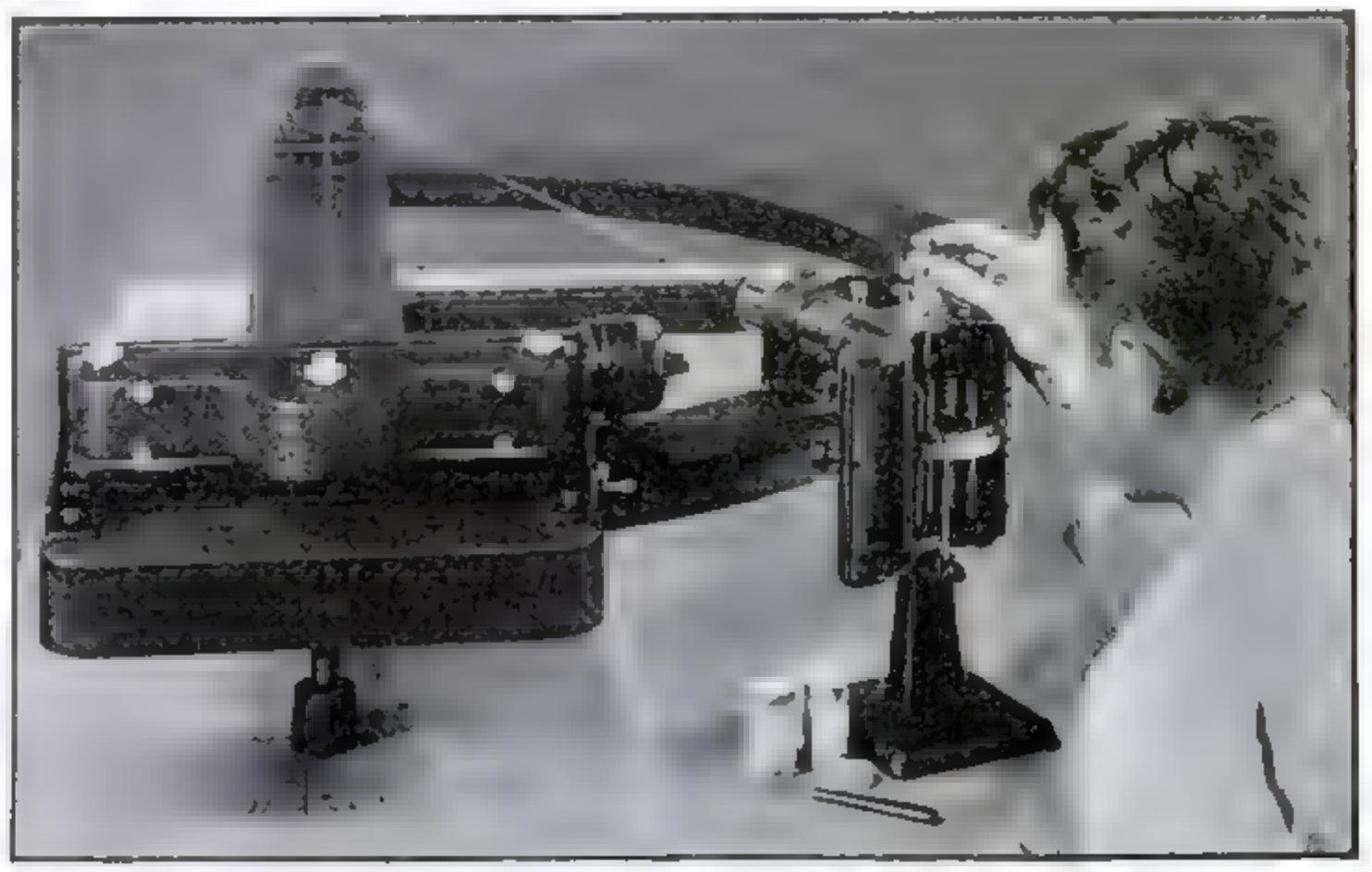


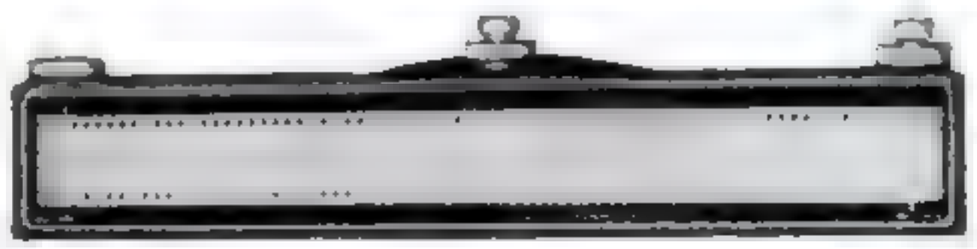
An elaborate research apparatus used for testing the torsional strength of metal

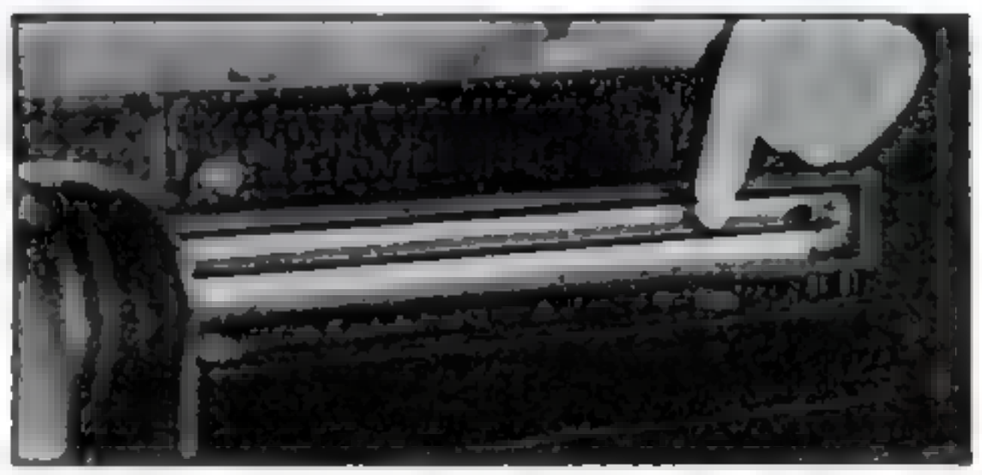
A room finished in aluminum. It has walls of the metal especially treated and colored. The trimmings are in natural aluminum and drapes are made of mesh

"Spectral Detective" *Finds Telltale Clews in Bands of Flame*

With a new wonder instrument, science can now test abandoned ore dumps like this, to determine the presence and amount of rare minerals







MEASURING MINUTE QUANTITIES OF MATTER BY SPECTRAL ANALYSIS
At top, the machine in use. The substance to be analyzed is placed in the concave tip of a carbon electrode, as at right. Light is projected along dotted lines to camera seen in center close-up. At left above, the rotating sector that divides spectrum for quantitative analysis

NICKNAMED "the spectral detective," a wonder instrument so sensitive that it detects and measures as little as one ten-millionth of a gram of a substance—a speck far too small to see—has been perfected by two young graduate scientists of the California Institute of Technology. Its feats rival the accomplishments of scientific sleuths of fiction.

A chip of paint is found in the clothing of a hit-and-run driver's victim. With the aid of the new instrument, it is compared with paint from the fender of a suspect's car. The composition of the two samples proves identical, and the suspect is convicted.

A prospector brings in a chunk of ore. Assayers have found nothing in it worth mining for, but in an hour's time the "spectral detective" reveals seven rare elements. Several of them—including gallium, a strange metal that melts at body temperature; germanium, a metal that hardens copper; and indium, used for bearings in fine watches—are far more valuable than gold!

A mineral spring is discovered. Does its water contain any substances of medicinal value and, if so, in what proportions? Samples of the mud from the spring are placed in the instrument and the elements they contain are determined at once.

To perform feats like these, without recourse to the conventional long-drawn-out processes of chemical analysis, the "spectral detective" applies a principle familiar to any schoolboy who has passed sunlight through a glass prism and has observed the spectrum or rainbow of colors that is formed. Light from an incandescent metal or mineral may also be spread into a spectrum. In this case, bright lines of various colors will be seen alternating with dark portions of the band, each element producing its own characteristic pattern.

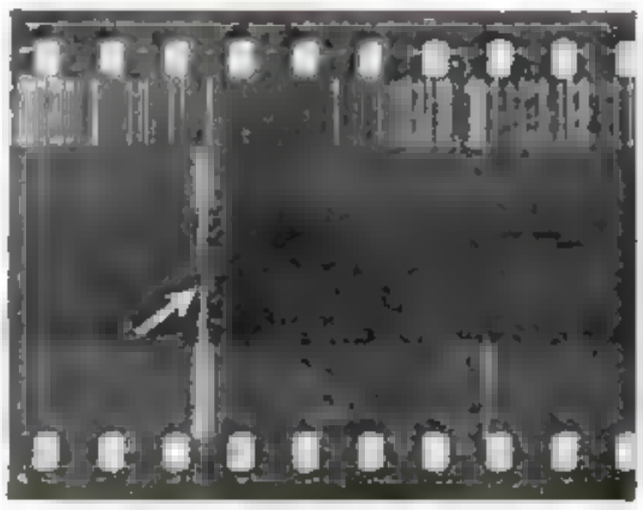
To take advantage of this phenomenon, a pinch of a substance to be tested by the new instrument is placed in the hollowed-out core of a carbon electrode and heated to 10,000 degrees F. Light from the glowing sample, formed into a spectrum, is projected upon a strip of photographic film. When the film is developed, the position of the transverse markings left by the telltale luminous lines shows what elements were present in the sample.

But this is not enough. The quantities, too, must be determined. Even if an abandoned mine dump is known to contain precious metal, for example, a mining syndicate will still want to know whether there is enough to justify reworking the dump. The brightness of the lines made by the "spectral detective" supplies the answer; it is an accurate indication of the quantity of each particular element that is present, and each hidden quantity is measured ingeniously.

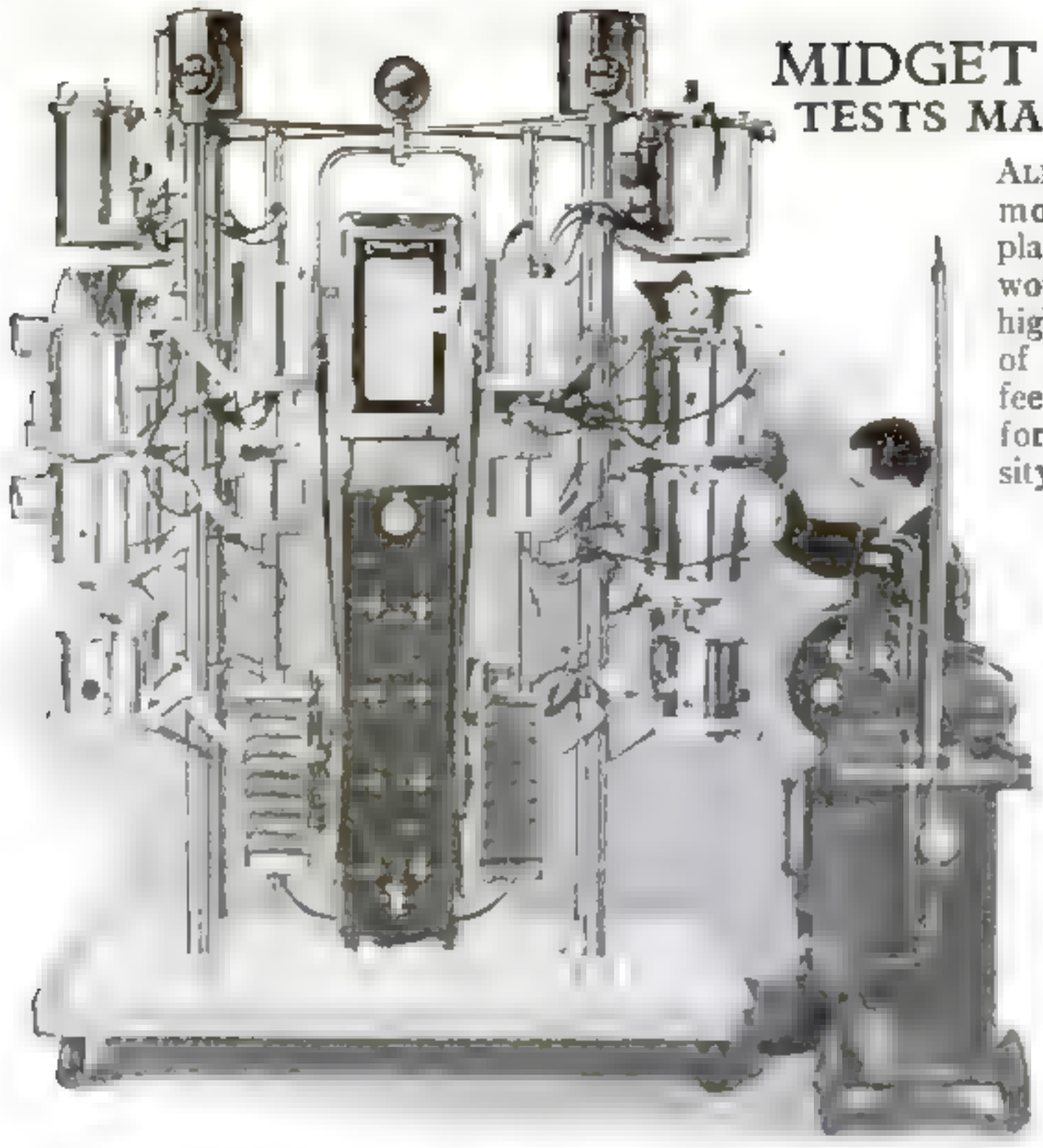
Light from the glowing sample, before it reaches the film, must pass a rotating strip of black-painted wood that cuts down the exposure along the central zone of sensitive emulsion. Hence, the recorded lines appear to fade out at the middle, leaving gaps that vary in width according to the brightness or faintness of the original lines. By measuring the gaps, and using similar spectrum photographs made from samples of known composition for comparison, it is possible to estimate precisely the percentage of any one of seventy elements in the sample.

One of the new instruments is already serving the Los Angeles, Calif., police department. Other applications foreseen by the inventors, Dr. M. F. Hassler and R. W. Lindhurst, are almost limitless in scope; for the rapid, precise results obtainable with the "spectral detective" threaten to outmode much of the present technique of chemical analysis and assaying.

THE CAMERA RECORDS THE FACTS
A strip of film showing a calcium line trying to unite. Width of the gap indicated by arrow fixes amount of calcium in sample



MIDGET BREWERY TESTS MALT AND HOPS



Real beer is the product of this unusual piece of laboratory equipment

ALL the operations of a modern beer-making plant are carried out in a working model eight feet high and covering an area of less than five square feet, recently completed for Birmingham University, England. Called the world's smallest brewery, the miniature establishment will test hops, barley, and yeast, and carry out experiments in brewing research. The model consists of four independent units, capable of producing one gallon of beer apiece from each brew. Brewing conditions in any given plant may be simulated, and it is possible to duplicate any local variety of beer or ale.

Below, a driver signaling a left turn with luminous wand. Inset shows how dry cells are placed in transparent shaft

LUMINOUS WAND GIVES NIGHT-DRIVING SIGNALS

A NEW aid for car drivers is an illuminated wand for giving traffic signals at night. Made of a translucent colored material, the hollow staff contains a small flash-light bulb and battery. Light from the bulb is diffused along the entire length of the device, which is mounted on a bracket and may be raised or lowered.

POLISHING WHEEL IS OF ROPE FIBER

STRONG rope fiber and a binding agent are combined to form a new type of metal-polishing wheel. The novel construction provides a resilient, cushioning backing for abrasive material glued to the outer surface, and facilitates rapid and smooth work. According to the maker, it is well suited for operations in which wheels of felt, leather-covered wood, and canvas are now employed. Wheels of the new type are available in various sizes.

Rope-fiber polishing wheel before application of abrasive

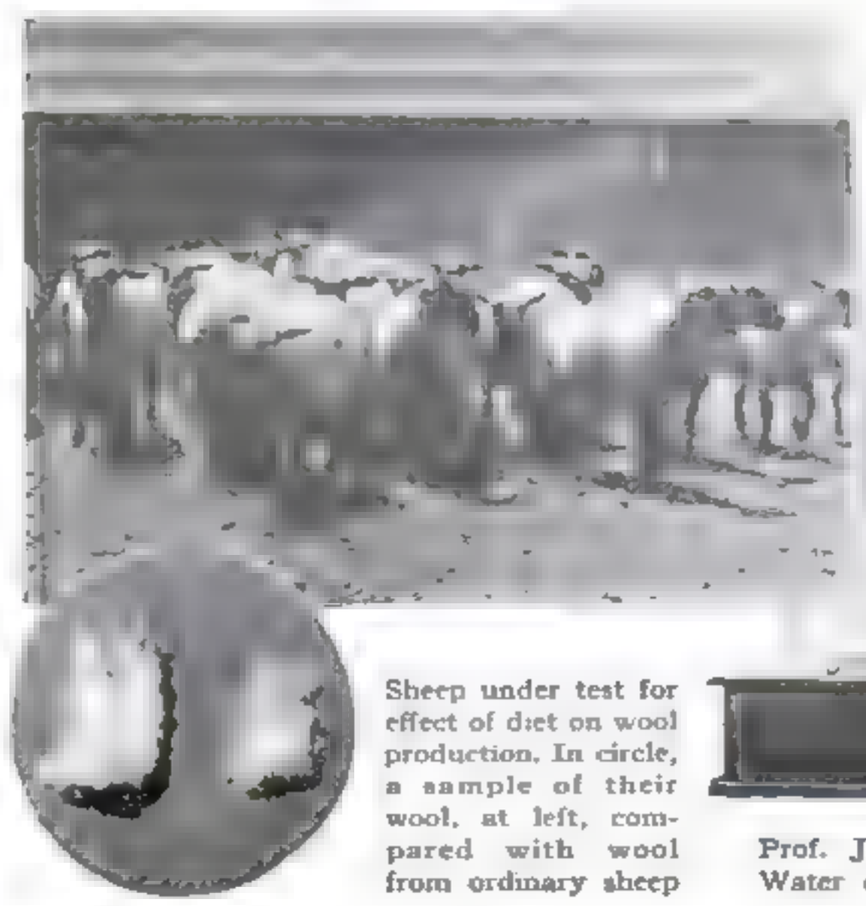
FURNACE SPINS TO MAKE GREATER HEAT POSSIBLE

WHIRLING at high speed, a new French electric furnace is said to develop temperatures of more than 5,000 degrees F. to melt refractory materials in powdered form. Ordinary smelting-furnace walls melt at about 3,200 degrees F., but in this machine the powder to be fused is thrown against the outer walls by centrifugal force, thus lining the wall surface with heat-insulating materials. A resistance rod, forming the central axis, supplies the heat.

Rotary electric furnace for melting powdered refractory materials

SHEEP GO ON DIET TO GIVE BETTER WOOL

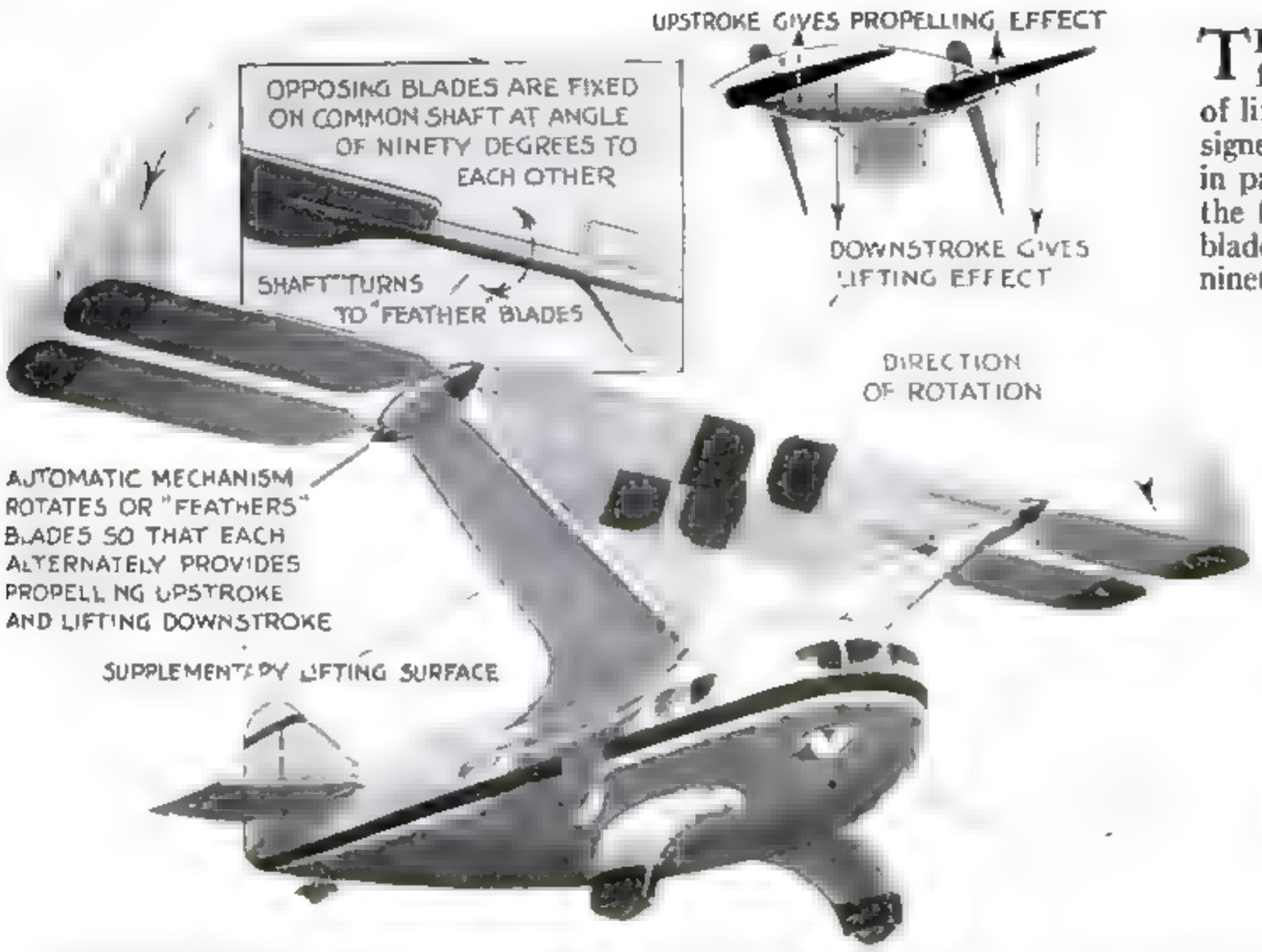
BY FEEDING sheep a special fattening diet, it is reported, a California expert has produced a superior wool twice as strong as the ordinary variety, promising clothing and fabrics that will wear far longer than those of today. Groups of sheep, kept in pens at the University of California Agricultural College, were fed upon a scientifically planned ration that caused them to gain weight and improve in health. At the end of six months they were sheared. Then their diet was changed to the ordinary ration of sheep on the range, and they were sheared again after another six months had passed. Tests of the two types of wool, made in the air-conditioned laboratory of Prof. J. F. Wilson, wool technologist, showed the breaking strength of wool from the specially fed sheep to be more than twice as high as that of the other samples. In addition, the yield of wool was 343 percent greater.



Sheep under test for effect of diet on wool production. In circle, a sample of their wool, at left, compared with wool from ordinary sheep

Prof. J. F. Wilson, gauging strength of wool. Water drops in a cup until weight breaks hair

PADDLE-WHEEL PROPELLERS LIFT AND DRIVE NOVEL PLANE



Proposed design of wingless plane, showing how propellers will provide support and traction

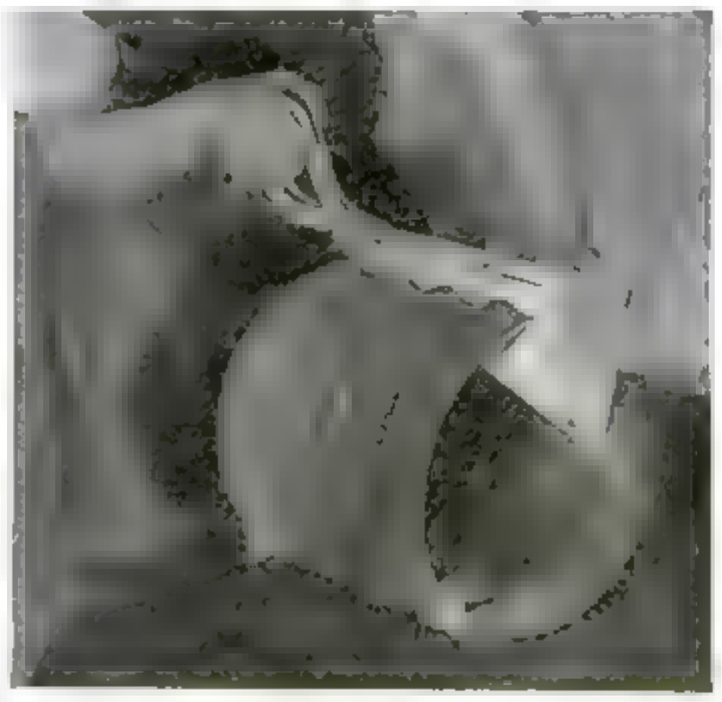
THRESHING the air like giant paddle wheels, four huge propellers serve the double purpose of lifting and propelling an odd wingless plane designed by two Denver, Colo., inventors. Mounted in pairs on struts jutting obliquely upward from the fuselage, the "propeller wings" have opposing blades fixed on a common shaft at an angle of ninety degrees to each other. An automatic mechanism turns the shafts to "feather" the blades so that each upstroke propels the plane forward and each downstroke provides lift. Drive shafts in the struts connect the blades with the motor in the fuselage. The pilot may control blade pitch to gain either greater speed or more lift.

COUNCILMEN VOTE BY ELECTRICITY

ELECTRICITY speeds up the voting of the council that governs Middlesex County, England. Votes of members are recorded on an electrically lighted panel placed near the chairman's desk. To vote "yes" or "no" on a proposed measure, each member presses one of a pair of buttons on his desk, and a colored bulb lights up on the panel to indicate his vote, enabling the chairman to tell at a glance whether members have passed or rejected the proposition. It is expected that this system will save much time.

Colored lights on this panel take the place of ballots

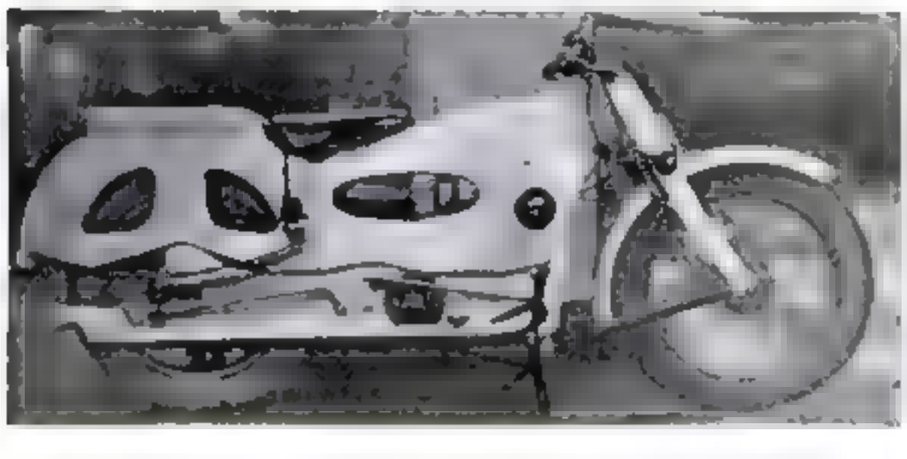
TRIANGULAR HACK SAW CUTS ONE-INCH METAL



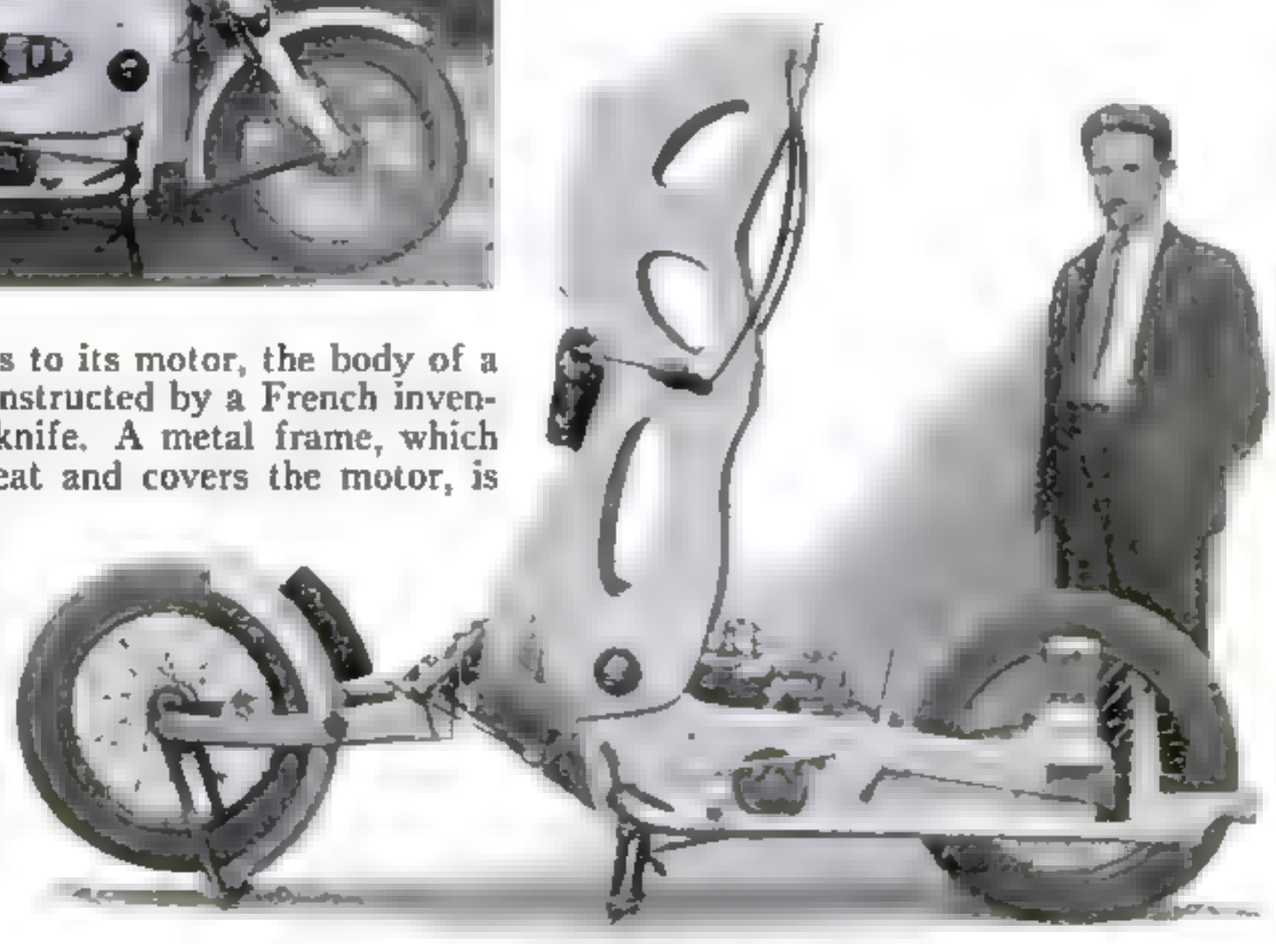
Triangular-bladed hack saw ripping heavy metal

METAL up to one inch in thickness may be cut or ripped by a novel triangular-shaped hack saw. The odd design permits the blade to move diagonally through the material while the frame goes back and forth in a horizontal position. The blade is protected by stainless-steel webbing and is loosely screwed to the frame, making it practically impossible to break it, according to the makers. The tool may also be used to saw wood or composition material.

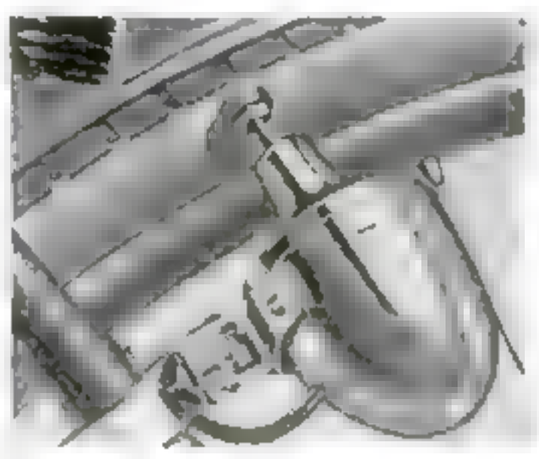
MOTOR CYCLE HAS JACKKNIFE CHASSIS



At left, motor cycle with seat frame that lifts to expose the motor. Below, the frame raised to give access to motor and chassis



TO ALLOW easy access to its motor, the body of a motor cycle recently constructed by a French inventor unfolds like a jackknife. A metal frame, which supports the driver's seat and covers the motor, is attached to the chassis so that it may be tilted straight up in the air, exposing the motor to full view. No extensive adjustments are necessary preparatory to raising the frame, and the tilting may be done in a few seconds, it is claimed.



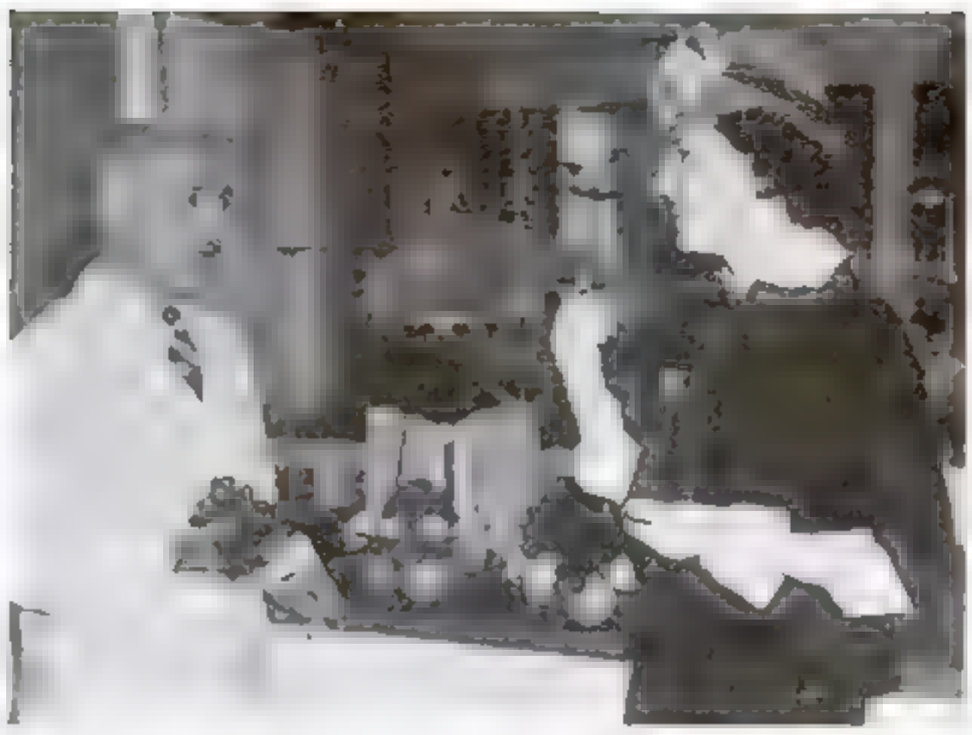
BIKE CARRIES OWN GENERATING PLANT

ELECTRICITY for bicycle lights is supplied by a new generator that operates by contact with the bicycle's rear wheel. Contained in a streamline shell, the unit is attached to the frame under the seat as shown in the photograph above. At a speed of eight miles an hour, it is said that sufficient current is generated to operate both head and tail lights.

METAL SPHERE IS ROLLING GYMNASIUM

By shifting the weight of his body, an athlete can roll this hollow sphere

FUN and exercise are provided by a metal sphere devised by two French inventors. By using hand and foot grips within the ball, and shifting his weight in acrobatic maneuvers, an athlete can propel himself about, as shown in the accompanying photograph. Made of a latticework of metal strips, the device rolls in any direction.



Experimenter submits samples of fruit perfumes for trial

PERFUME MADE FROM FRUITS RIVALS SCENTS OF FLOWERS

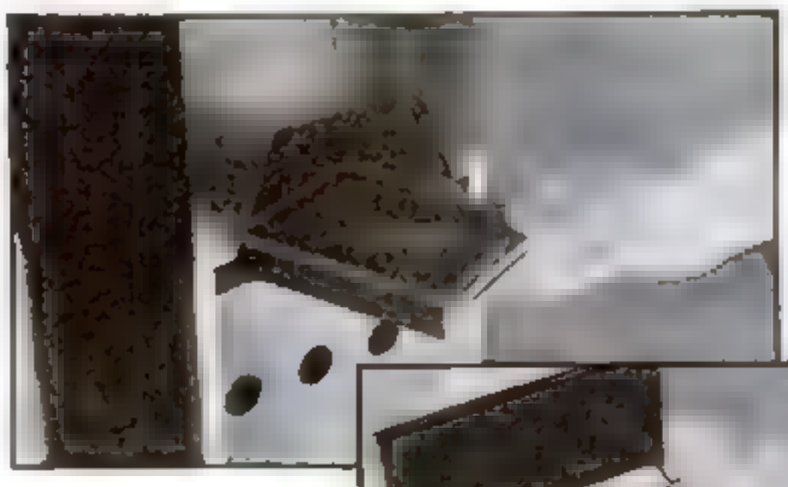
A NEW use for California fruits is foreseen by a western specialist, whose experiments convince him that they may be employed in the manufacture of exquisite perfumes. Through a series of processes that he has developed in his laboratory, the aromatic oils contained in oranges and other fruit are extracted and blended, producing scents that are said to rival those of the most fragrant flowers.

PIPE BOWLS X-RAYED FOR FLAWS

So THAT smokers may be sure of what they are getting, a leading maker of pipes takes an X-ray picture of each bowl. This reveals any defects which might later cause a cracked bowl.

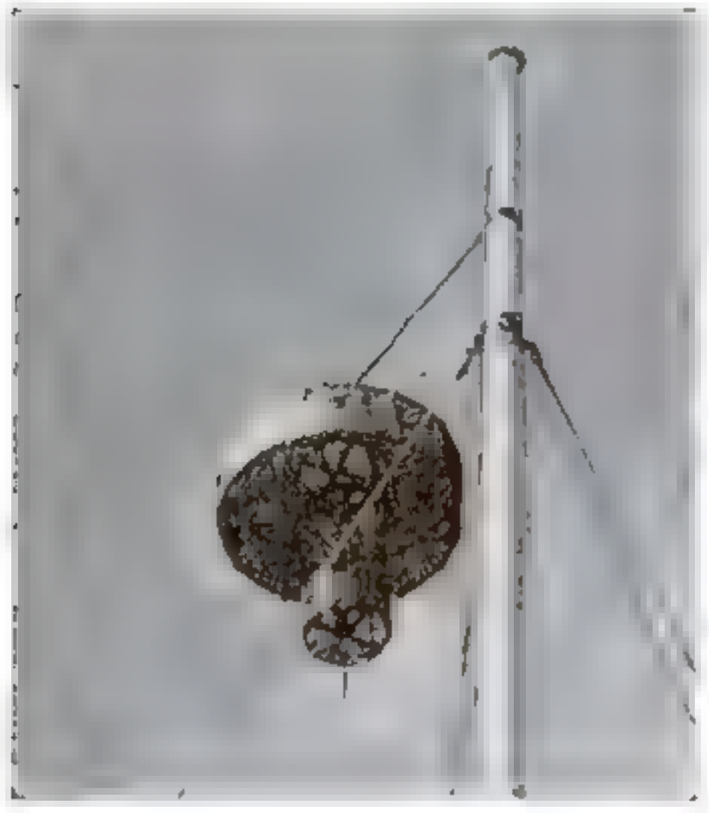
THREE-IN-ONE AID FOR PHOTOGRAPHERS

THREE different appliances—an enlarger, a contact printer, and a retouching desk— are combined in a single piece of apparatus introduced for amateur photographers. Prints or enlargements up to eight by ten inches in size may be made. A negative to be enlarged is placed in a booklike holder and slipped in the side of the device, which is set for size by means of a focusing knob. Paper is inserted at the top, and the exposure is made by depressing and releasing a platen handle, automatically operating a self-contained lamp. For contact prints, both negative and paper are placed in the top of the device. The platen may be unlocked and swung out of the way, permitting retouching to be done on a well-illuminated base that may be tilted to the angle at which it is most convenient to work.



A negative being placed in a booklike holder at the side of the unit, to make an enlargement. At right, a special holder for strip film. A focusing screen of ground glass is a part of the outfit

In making an enlargement, paper is inserted at the top and a platen handle is depressed as illustrated

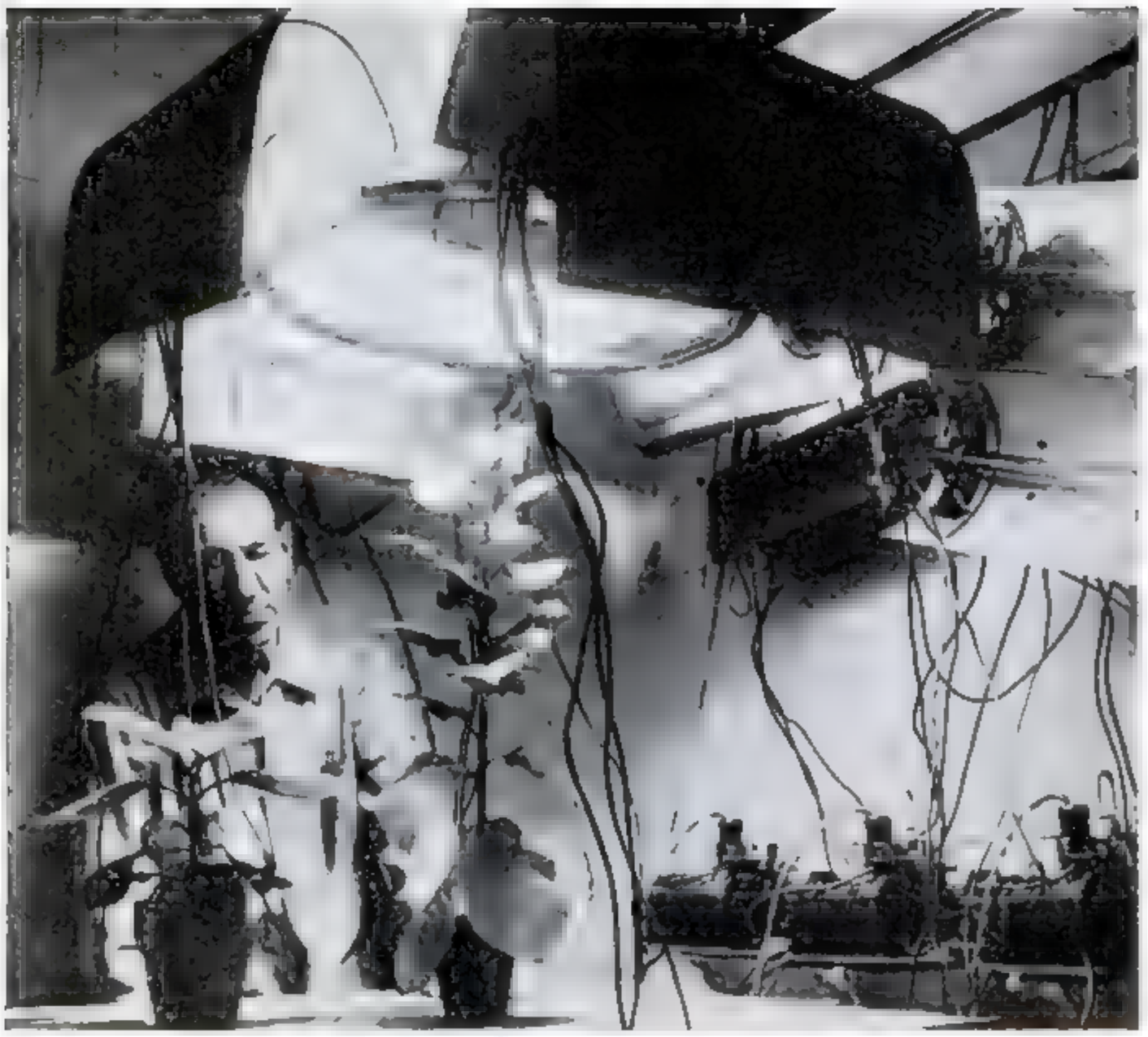


ODD WARNING SIGNALS GIVE TYPHOON ALARM

WATER craft scurry for cover when signals resembling gigantic bottle stoppers are hoisted on masts along the coast of Hongkong, in the China Sea. The odd warnings herald the approach of a typhoon, and are raised whenever one of these violent storms comes within 300 miles of the colony.

STRETCH LIFE OF RUBBER

DUE largely to constant and systematic industrial research, the average service life of rubber and rubber goods has been doubled since the World War, according to a statement of a leading rubber industrialist.



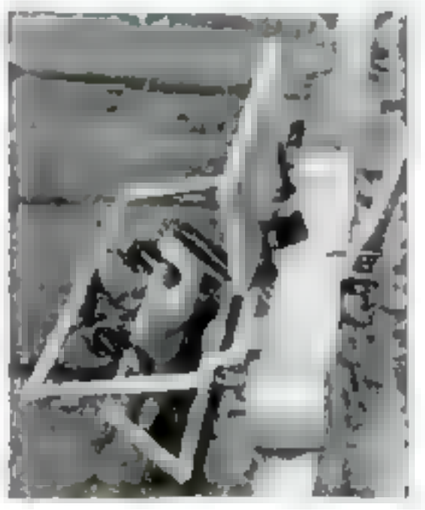
An experimenter examining exotic plants grown indoors under sodium-vapor light

PLANTS PREFER SODIUM LIGHTS TO SUN

SODIUM-vapor lamps, already heralded as an outstanding improvement for highway lighting, also provide the best illumination so far discovered for growing plants, according to experimenters of the Boyce Thompson Institute for Plant Research at Yonkers, N. Y. Buckwheat and other test crops, under the yellow rays of the new lamps, grew more rapidly and showed more sturdy development than similar plants grown under natural sunlight, they report. Neon tubes resembling those used in advertising signs were found to provide illumination nearly as stimulating as that of sodium vapor, and both proved more beneficial than ordinary incandescent lamps.

TRACKWALKER'S AID SHOWS HIDDEN FLAWS IN RAILS

EQUIPPED with a new aid, a railroad track inspector can easily spot hidden cracks and defects in rails. As the device is pushed along on rollers, mirrors reflect light upon the underside of the flange, and serve as a periscope for the easy examination of the under surface.



Close-up of rolling periscope. Mirrors give view of under surface of rail

Trackwalker using device to look for flaws in rails

COUPES GET MECHANICAL LOADER FOR LUGGAGE

STOWING luggage away within the rear compartment of a coupe, and removing it, is made easy by a mechanical loader recently marketed. The device consists of a platform mounted on rubber wheels which run on tracks fastened to the deck-compartment floor. Luggage can be arranged conveniently at the rear of the deck, and then moved forward by turning a crank which operates a simple cable mechanism.

Rolling platform stows luggage in compartment

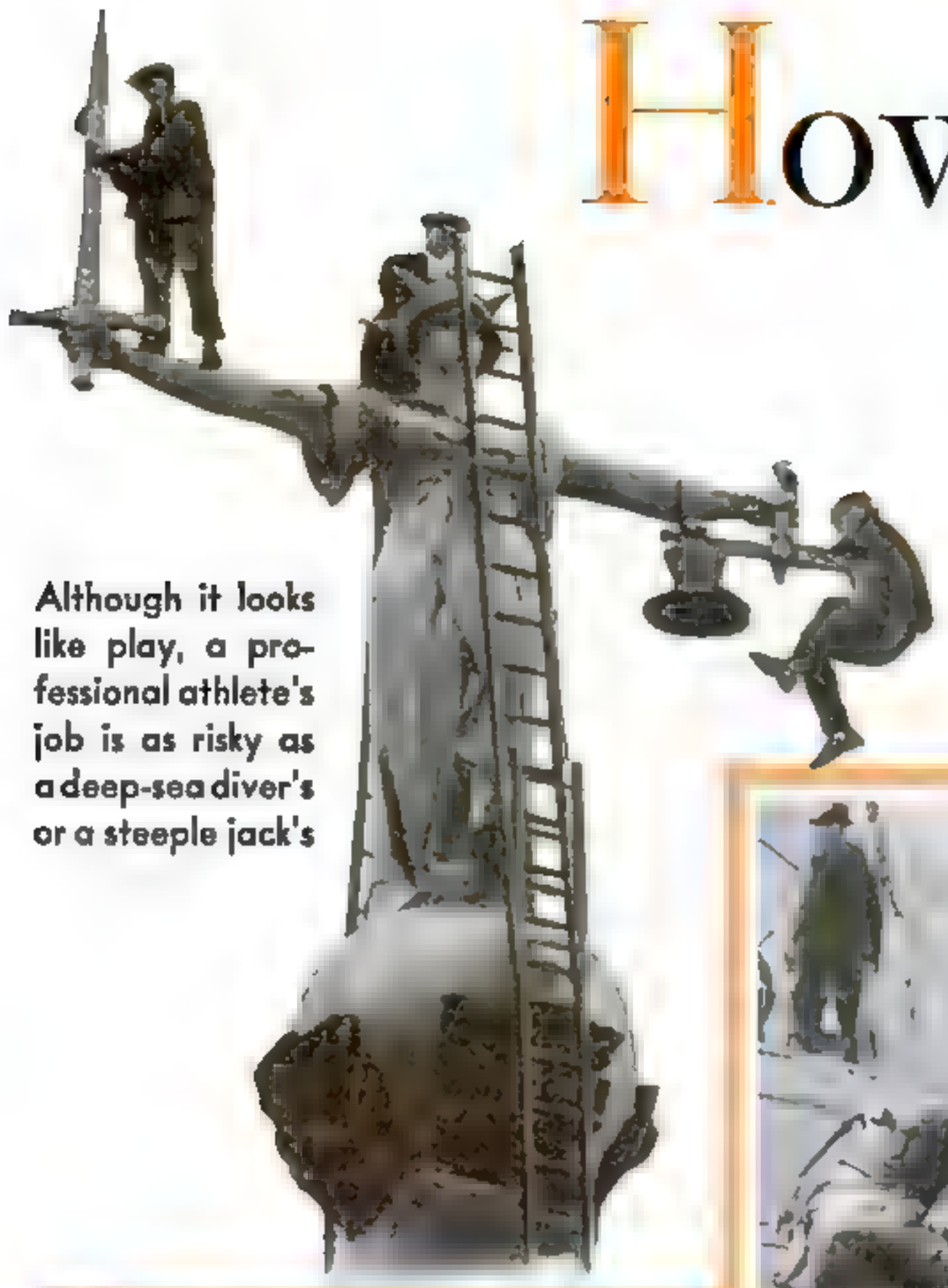
Left, interior of unique window-testing laboratory, showing adjustable ceiling. The picture below shows exterior of building, with brightness meter mounted on the roof

STUDY WINDOW SIZES IN ODD LABORATORY

HOW MUCH daylight comes in a window? To supply data long needed by architects, as a guide in designing windows for homes, offices, and factories, the United States Public Health Service has erected a unique experimental structure near Arlington, Va. Brightness, dimness, or glare in any part of its single room is measured by an instrument employing a photo-electric eye, while experimenters block off window sections with shutters, roll false walls into position, and raise or lower movable ceilings. Research workers atop the structure, meanwhile, constantly record the brightness of the sky as a check on the interior measurements, using a brightness meter that resembles an antiaircraft listening device. Thus information is obtained as to the comparative effectiveness of windows of varying size and shape. One conclusion obtained is that increasing the height of a window produces considerably more improvement in illumination than a corresponding increase in its width.

How Dangerous

By JESSE F. GELDERS



Although it looks like play, a professional athlete's job is as risky as a deep-sea diver's or a steeple jack's

HOW dangerous is your job? What are your chances of being killed, or temporarily or permanently disabled? More than they would be at other work—or less?

Those are broad questions, but I found an accident-insurance company ready to give amazingly definite answers. And the answers were full of surprises.

A prison warden faces less danger than a diamond cutter, I learned. An ambulance driver's job is as safe as a garage mechanic's. Driving a heavy truck is riskier than either; it's as dangerous as moving buildings!

Whatever your job may be, the insurance company can estimate, in actual figures, how much more dangerous—or less dangerous—it is than any other given job.

Insurance experts have classified some 5,000 occupations, dividing them into ten separate groups according to hazards. Those ten degrees of danger can be illustrated by ten names, one picked at random from each of the ten classes: (1) bookkeeper, (2) food inspector, (3) camera-lens grinder, (4) ambulance driver, (5) tree pruner or nurseryman, (6) cabinetmaker using machinery, (7) structural-steel riveter, (8) coal miner, (9) freight brakeman, (10) steeple jack. Change from any of those jobs to a higher-numbered one, and you take a step toward injury or death!

The rates charged for accident insurance show *how much* the hazard increases. If a bookkeeper becomes a nurseryman he doubles his risk. A brakeman is in more than seven times as much danger as a bookkeeper; he can't even get the same kind of insurance. Many companies won't write a policy of any kind for a steeple jack; that indicates the peril of *his* job!

The steeple jack shares the hardly desirable distinction of having the "most dangerous job" with scores of workers in other widely assorted fields. Undersea divers, aviators, auto racers, caisson men working in compressed air, makers of high explosives, professional athletes, including baseball players—all of them face such great risks that they are usually described by the terse comment: "Not insurable."

The estimates of danger are not just guesswork. Their accuracy is continually being sharpened by scientific calculations. It is not a mere matter of counting deaths and injuries; if it were, many jobs might be considered much safer. Unexpected influences enter into the figures.

In the infancy of accident-insurance companies, some sixty years ago, they used plain horse sense to classify occupations. Those that seemed to have the same sort of hazards—for instance, jobs that required the same tools—were grouped together.

Now, however, the companies have actual records of millions of accidents, and a gauge of their seriousness, in dollars and cents. Last year alone they paid out $90,000,000 for injuries, deaths, and sickness. When there is a question about the dangers faced by persons employed in any kind of work, a large company takes from its files the records of all the policies covering that particular occupation, over a period of six months, or a year, or several years. The amounts paid out in settlement of claims are added up and compared with the total premiums collected. The comparison shows immediately whether the danger has been greater or less than it was estimated.

Some years ago, a dentist was regarded as one of the safest possible risks. He was

When a dentist works on your teeth, he stands the same chance of getting hurt as a woodworker using sharp hand tools

Is Your Job?

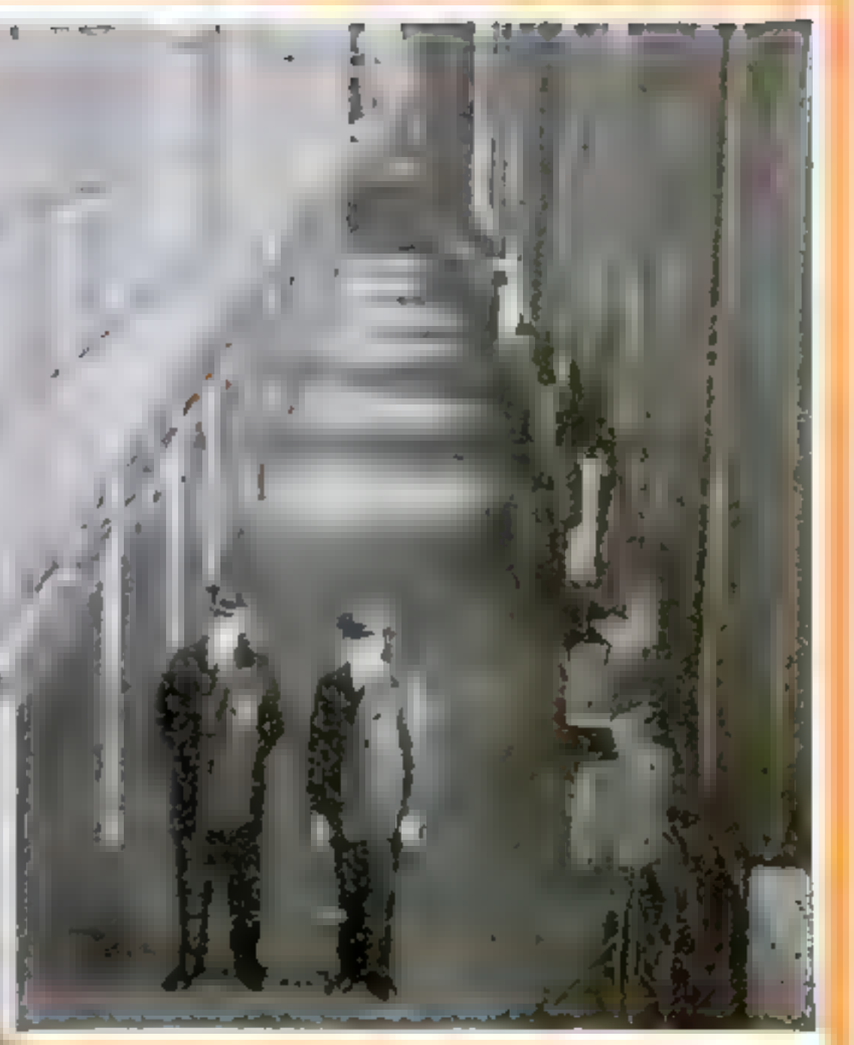
in the first class, with bookkeepers, bank clerks, editors, librarians, telephone operators, and other inside workers, safer at their jobs than they would be on the street.

But scores of dentists injured their hands and fingers. They were bitten or bruised by patients' teeth. They were cut or scratched by their own instruments. Many of those injuries caused temporary but complete disability, especially if infections developed. A dentist couldn't put an infected, bandaged finger into a patient's mouth.

A large group of insurance companies checked up their claims, and shifted dentists from the first class to the third. A dentist's work makes him about fifty percent more liable to disability from injury than a bookkeeper, a banker, an editor, or any of the snugly safe inside workers.

Exactly the same change was made in the rating of building contractors who stayed in the office and visited the actual job only occasionally. They used to be considered as safe as bankers. But they went to the job so often that their accident record was as bad as dentists'. Just a few months ago, during the alteration of a building in an eastern city, a contractor fell through a hole in a catwalk, and was killed. He had gone to the building only to inspect it.

In spite of the risk of jail breaks and riots, a prison warden is safer while on duty than is a diamond cutter at work at his bench



It isn't as strange as it may seem at first to call two occupations equally dangerous when one may cause a man to plunge to his death, while the principal hazard of the other is sore fingers. Accident insurance companies can't measure peril in terms of pain or grief; their gauge is marked in dollars and cents. Finger injuries, if they cause loss of time from work, and if they occur often enough, can be more costly than occasional deaths

Last year a foreman in a factory making a patent medicine went into an empty tank to examine it. He carried an electric light. An explosion occurred—probably due to the accidental breaking of the light bulb and igniting of alcohol vapor—and the man was killed. The job which led to that tragedy is listed in the fourth class.

And in the next class, *more dangerous*, is the repairing or operating of a sewing machine!

Prison wardens' lives have been endangered often by mutinies and jail breaks. Yet the warden's job, measured in terms of accidents, over a period of years, is as safe as a food inspector's. A diamond cutter, or a jewelry maker, for whom a little slip may mean an injured hand and temporary disability, is in about a third more danger than the superintendent of a penitentiary.

In every occupation, the chances of loss by accident depend not only upon the likelihood of the accident but also upon its consequences when it does occur. This is the explanation of at least a part of the hazard in many of the "most perilous" jobs.

Not only is a baseball player more liable than a stock broker to sprain his arm but the injury is almost sure to prove more costly. A second baseman with his leg spiked may be in no more pain than a carpenter who has stepped on a nail but, other things being equal, the ball player's disability will be greater or longer than the carpenter's.

Accident-insurance statistics show that a locomotive engineer, driving a train on a fast run, is as close to peril as a riveter perched on the framework of a skyscraper

From a cold, mathematical viewpoint, one partially disabling accident is sometimes as bad as a fatality. A carpenter fell twenty feet from a scaffold and a hatchet, with which he had been working, severed four fingers. His policy named specific sums to be paid for the loss of hands, limbs or eyes, or for permanent total disability or death. But it did not mention fingers. The loss of four fingers totally disabled the carpenter

(Continued on page 130)

Living Rat Traps

RAISED ON NOVEL FARMS

DEATH TO RODENTS

A brown or fitch ferret in a nest at the Farnsworth farm near New London, Ohio. The slender, streamline head is typical of the breed

A house in which ferrets are bred. Under the eaves, and running the full length of the building, is a screened window for ventilation

An overhead trolley used for transporting food to the houses and removing straw

"IF A MAN . . . make a better mousetrap than his neighbor," someone said, "though he build his home in the woods, the world will make a beaten path to his door." The truth of this statement is being realized with profit by a number of "farmers" in the vicinity of New London, Ohio; only the traps are *raised* and not built, and they work equally well with rats, prairie dogs, and squirrels. New London is known as the ferret center of the world, because more of those animals are raised there than in any other place, some 25,000 a year being a conservative present-time estimate.

A ferret is a small, slender animal of the weasel family. The typical ferret is about fourteen inches long, with a 5½-inch tail. Its body is long and slender, its head small, and its nose pointed. Ferrets are native to Africa, although some authorities say that they came originally from Asia. The ferret has been raised in captivity for so many years that it cannot exist very long in the wild state.

Two varieties of ferrets are raised on a commercial scale, for hunting rats and other animals. One, the fitch, is brown in color, with brown eyes, and looks something like a mink. The other type is the English or white ferret, which has pink eyes and is the same size as the fitch. About the only difference between the types is their appearance. Both kinds are good hunters.

Scattered around New London are perhaps a score of ferret farms. One of the largest of these is operated by Levi Farnsworth, who has been raising the animals for forty-five years. He has produced as high as 10,000 a year.

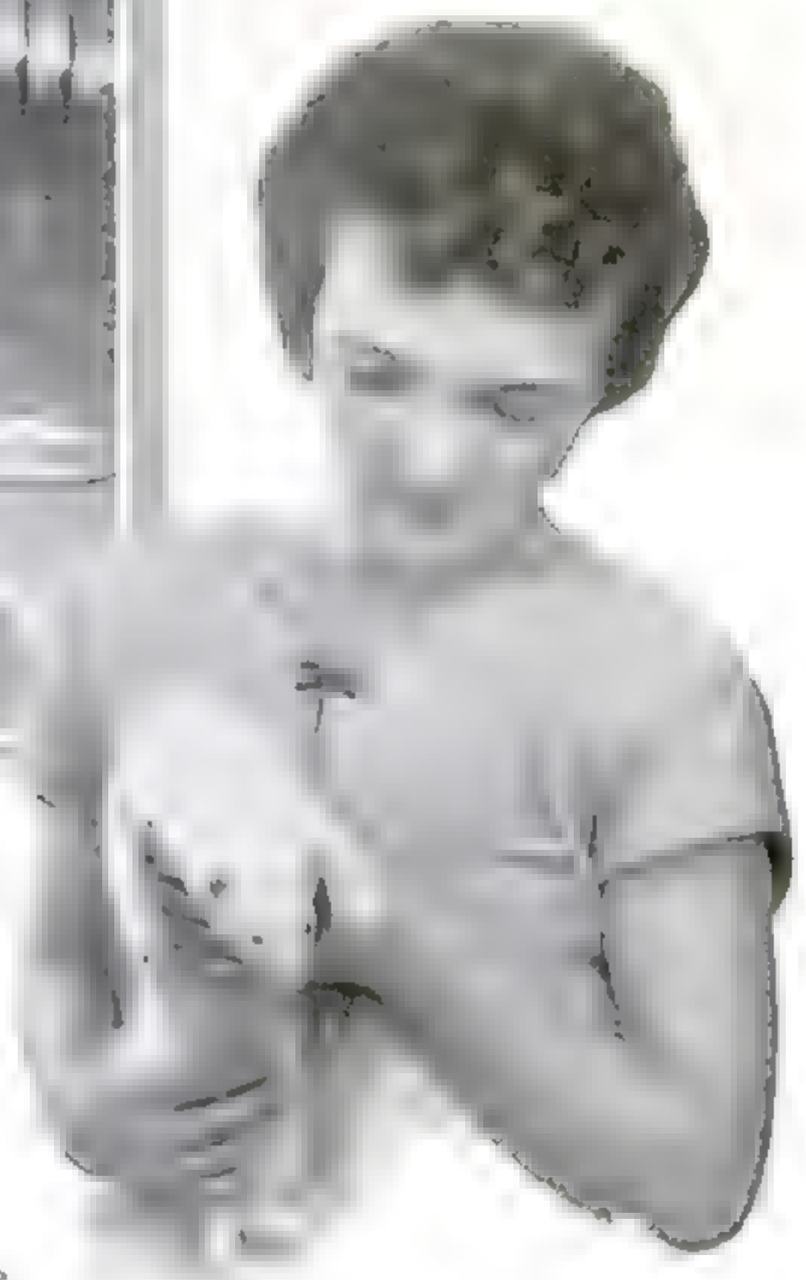
Farnsworth's interest in ferrets started accidentally, and somewhat startlingly, when he was a small boy. One day he was playing near the barn when he saw a strange animal stick its head out of a hole. It started towards him. He didn't wait for further investigation, but ran to the house. Breathlessly he described the animal, and did such a good job that everybody expected to see something as large and wild as a wolf. But when the monster was captured it proved to be a ferret, tame as a kitten.

Two weeks later, ten baby ferrets were born. Then the owner of the mother ferret was discovered. He was a neighbor who had brought a pair of the animals over from England. The ferrets, minus one pair, were returned to him. When that pair grew up, Farnsworth built up a local reputation with them, as a rat destroyer. Rat hunts were organized, and sometimes as many as seventy-five rats would be caught in one of these campaigns.

It was only natural that Farnsworth should start raising ferrets to sell. He advertised, increased his stock, and the enterprise grew until he now has one of the biggest ferret farms in the world, with about 2,000 animals in stock most of the time.

A ferret is a natural-born hunter. This makes it valuable as a rat exterminator. Turn a properly reared ferret into a nest of rats, and it will not rest until every one of them is dead. The ferret is the only animal, Farnsworth says, that has proved efficient as a rat hunter. Many of his sales are to companies that specialize in ridding office buildings, warehouses, stock barns, chicken coops, and

A worker ladling graham mush into the feeding pans of the individual pens. Below, an English or albino ferret shows its tameness. After becoming accustomed to its handler, a ferret cannot be induced to bite



In This Article, the Author Takes You for a Visit To a Strange "Ranch" Where Ferrets Are Bred by Thousands To Aid Man in His War Against Rodents

By WALTER E. BURTON

other structures of rats. They are widely used for cleaning out ships, where rats frequently become a great nuisance.

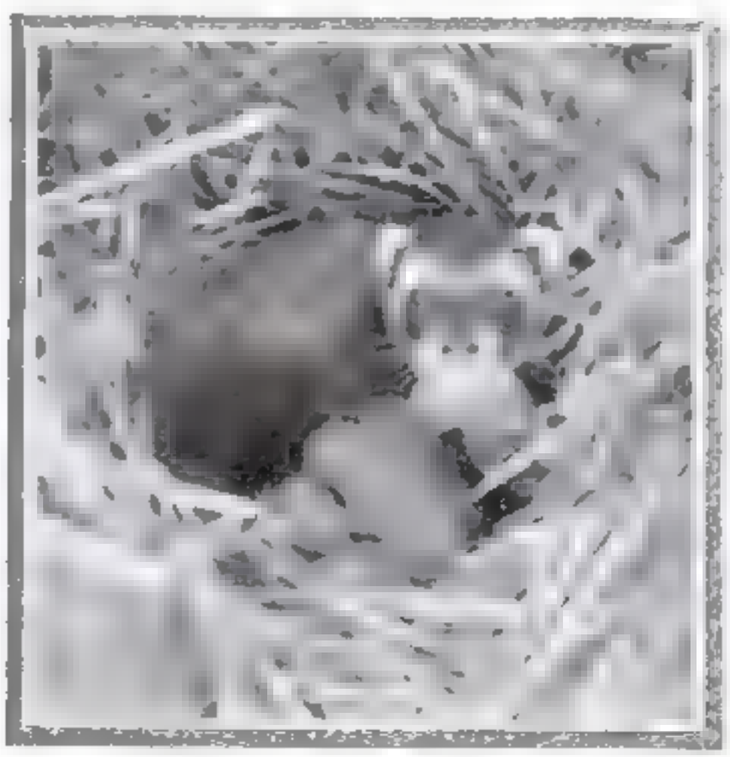
A ferret must be broken for rats before it can be called an efficient hunter. Farnsworth recommends that mice or young rats be placed in a pen with the ferret. The ferret gets the idea immediately but, because of inexperience, does not do a perfect job the first time. Little points of technique, like the proper neck hold to get on a rat in order to make it give up the ghost immediately, must be learned by practice. After the ferret has dispatched one or two small rats or mice, or grown-up rats whose most damaging teeth have been knocked out, it is ready to tackle the fiercest of rat fighters. The battle invariably is a brief one, with the decision always in favor of the ferret. The rat generally rears itself on its hind legs, ready to lunge at its foe. The ferret approaches the rat in a sidling manner. Then, quicker than the eye can follow, it whirls and grabs the rat by the neck. That is the end of that particular rat. A ferret seizes its prey and holds it as tenaciously as a bulldog. Its hold can be broken by pressing the thumb just above its eyes.

To rid a building of rats, ferrets are released where they can enter the rat holes. The animated rat traps seem to dash into the holes instinctively. They are built for work in such close quarters. In other words, they are properly streamlined.

Incidentally, in raising ferrets for the market, the goal is somewhat different from that sought in breeding most other animals. Whereas the raiser of fur-bearing animals, chickens, hogs, and the like, generally strives to produce the largest animals possible, the ferret breeder directs his efforts more toward the raising of small or medium-sized stock, which can wriggle through the smallest rat holes with ease.

Because of their rat-hunting abilities, one or more ferrets frequently are kept as permanent residents of mills, cellars, grain elevators, and the like. They will keep the surrounding territory completely free of rats. However, Farnsworth thinks it better for the ferrets not to run loose all the time, but to be housed in pens except when at work catching rats.

One reason why it is not wise to let ferrets roam over a farm is that they have a weakness for poultry. However, they can be used for ridding a poultry house of rats, simply by releasing them when the fowls are roosting. A ferret cannot climb, so that, when the chickens are off the floor, it cannot injure them. The fact that a ferret cannot climb, while a rat can, accounts for the apparent slowness with which ferrets sometimes rid a building of rats. The rats can go anywhere between the walls, but the ferrets must wait until the rats return to the ground before attacking.



Alarmed by the photographer, this mother ferret is ready to defend her litter. She is holding one of the tiny young ones in her mouth

That the ferret, as a rat hunter, is of real economic value can be seen by considering for a moment the rat situation. Surveys made by government agencies indicate that there is at least one rat for every man, woman, and child in the United States. Each one of these more than 100,000,000 rats destroys two dollars worth of food a year, on the average. This represents a loss that accounts for the full-time labor of 200,000 men. In addition to its destructiveness, the rat is a carrier of diseases—some of them, like the bubonic plague, extremely deadly. So, as a ratter, the ferret is a real friend of man.

To many persons, perhaps, the ferret is best known as a rabbit hunter. Its ability to invade the burrows of rabbits, and chase them out where hunters can get them, has led to its widespread use. However, many states now prohibit the use of ferrets for hunting, in order that the rabbit population will not be wiped out by too much efficiency on the part of hunters equipped with ferrets, which they carry about in their pockets or special pouches.

Purchasers of ferrets frequently devise novel uses for them. There is the case of the Kansas postmaster, who found them highly efficient for ridding land of prairie dogs. He discovered that two pairs of ferrets will clear seventy-five to 100 acres of prairie dogs in three or four months. The way he works is to keep the ferrets in a box with a wire *(Continued on page 127)*

ARMY DROPS FROM THE SKY TO TEST NEW WAR TACTICS

Soviet infantrymen descending from planes in parachutes and advancing in novel maneuvers

SOVIET Army officials recently directed more than 1,000 infantrymen in a spectacular mass parachute jump to test the possible value of such tactics in war time. Flown behind "enemy" lines during maneuvers, fully equipped soldiers bailed out of huge transport planes, descended to the ground, freed themselves from their parachutes, and advanced on foot ready for action. By this means it is proposed that a surprise attack could be directed against an enemy from the rear.

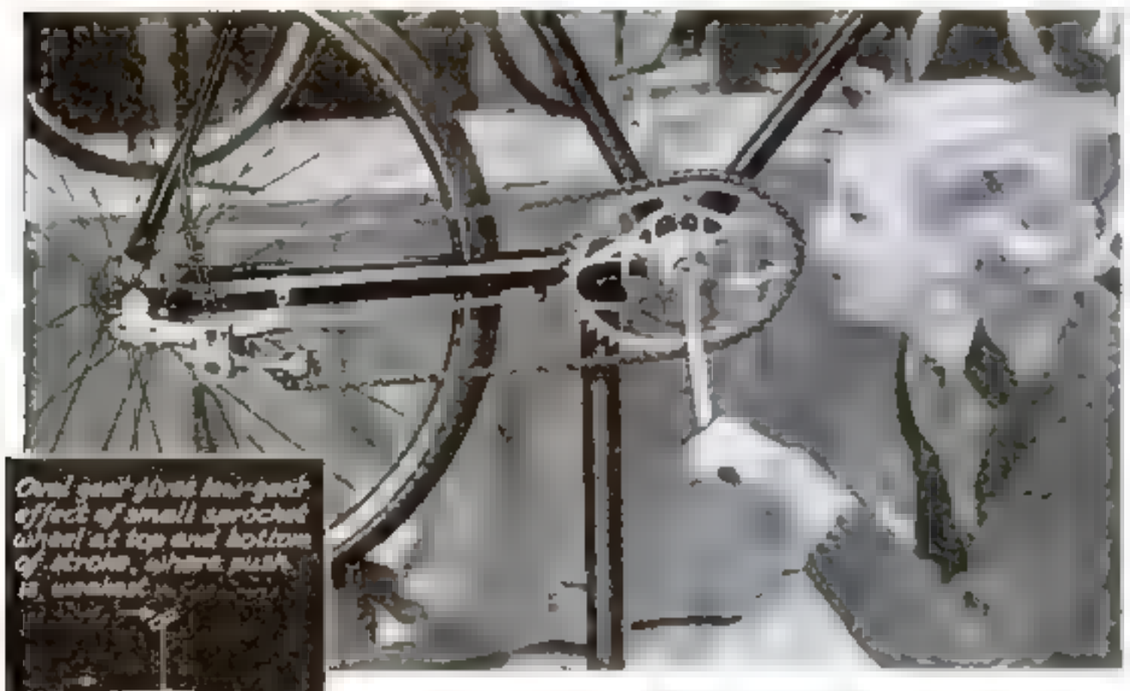
SHOES FIT OVER SKATES FOR WALKING TO POND

SPECIAL "overshoes" for ice skates now enable wearers to walk to and from their homes with their skates on. Pressed from sheet steel and perforated to decrease their weight, the attachments are fastened to ordinary shoes or ice-skate shoes by single ankle straps. They provide broad rubber treads that allow the wearer, despite his elevation from the ground, to walk in normal fashion. The blades of the skates are raised so that they are kept clear of the ground.

Skater with "overshoes" for walking in skates

AUTOMOBILE FOOT REST CONCEALS AN UMBRELLA

TUCKED away within a new automobile foot rest is a full-sized umbrella, ready for instant service in case of an unexpected shower. The end of the umbrella handle forms a cap that closes the tube, keeping out dust and dirt, and a friction catch prevents rattling. When the umbrella is to be used, it is easily slipped from its holder, as shown above. The foot rest, says the maker, can be installed in any car.



Bicycle equipped with new oval gear sprocket

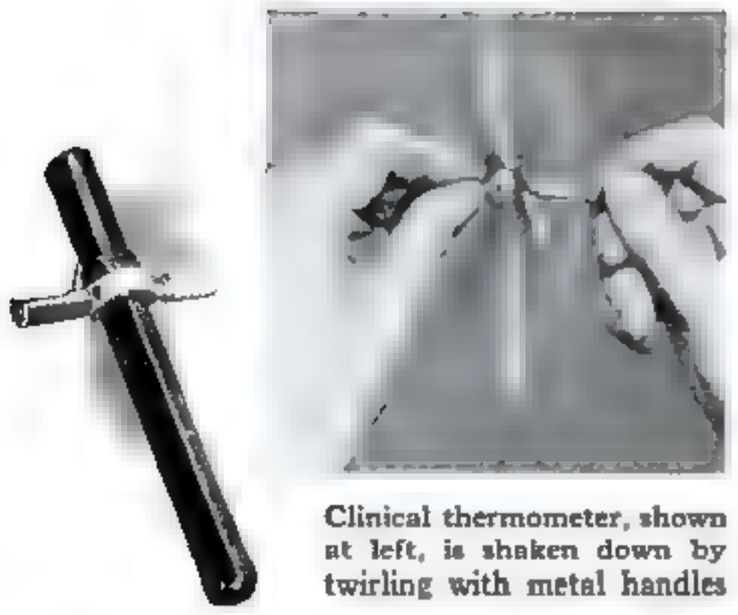
OVAL BICYCLE SPROCKET MAKES PEDALING EASIER

PEDALING a bicycle is said to be made easier by a novel gear demonstrated in London. Instead of the usual circular sprocket wheel one of oval shape has been constructed to give a low-gear effect at the weak top and bottom positions of the stroke, and a high-gear effect at the strong center position. An idler wheel maintains a uniform tension on the chain.

ROLLING WHEEL GAUGES DISTANCES ACCURATELY

LAYING out golf courses, parks, and pipe lines is made easier by the use of a measuring wheel with which, it is claimed, one man can determine distances more quickly and with less chance of error than two men using a tape. Rolling this device in front of him, the operator can mark off any distance by reference to a counter geared to the wheel, the circumference of which is exactly three feet. Inches are shown on a graduated hub disk.

This measuring wheel registers distances in feet and inches



Clinical thermometer, shown at left, is shaken down by twirling with metal handles

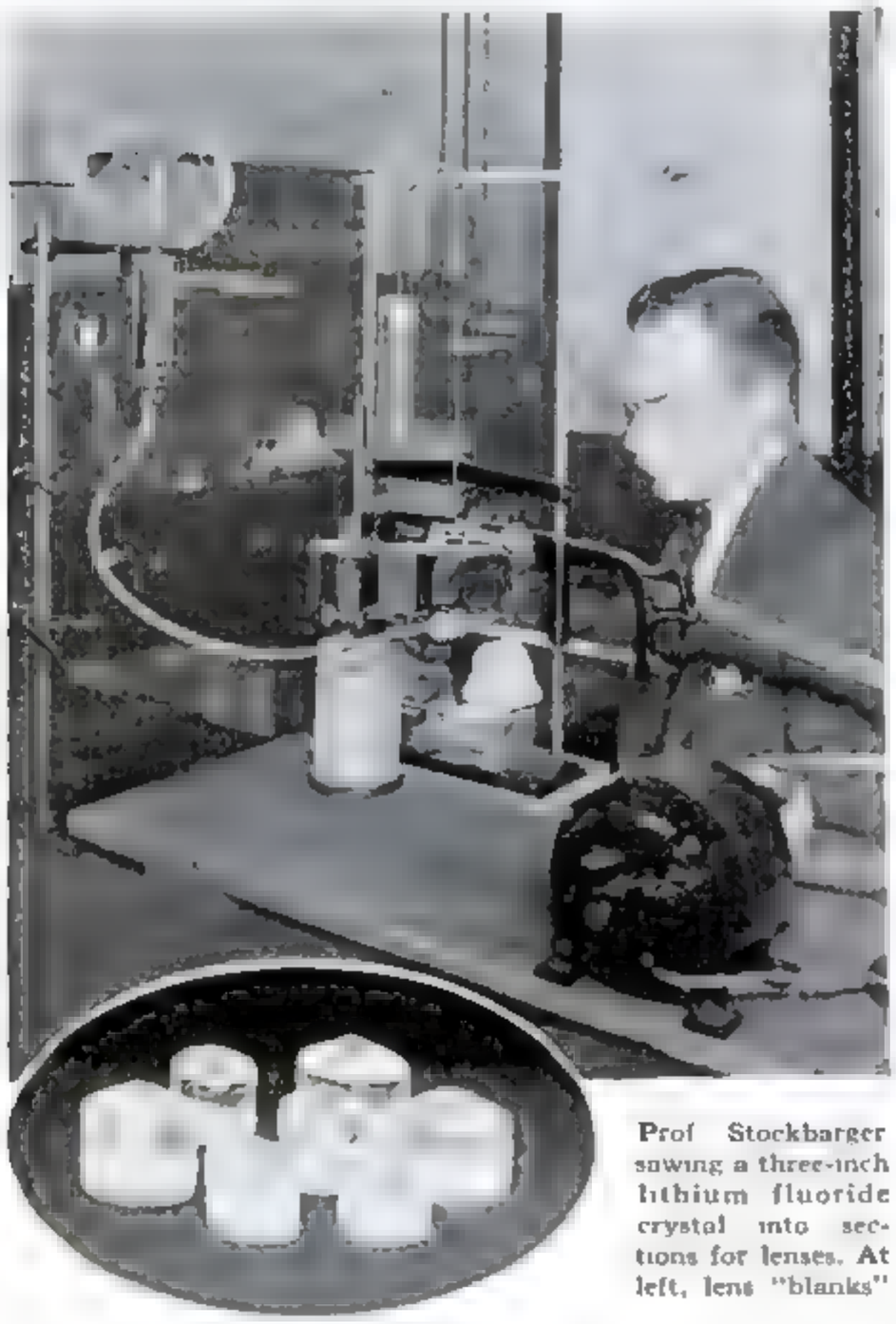
THERMOMETER TWIRLED TO SHAKE IT DOWN

To SAVE the trouble of shaking it down, a new clinical thermometer is provided with a case that may be twirled between the fingers. The spinning motion quickly drives the mercury to the desired level by the application of centrifugal force.

HIGHEST PRESSURE PRODUCES HOT ICE

Apparatus with which Prof. P. W. Bridgman creates high pressures

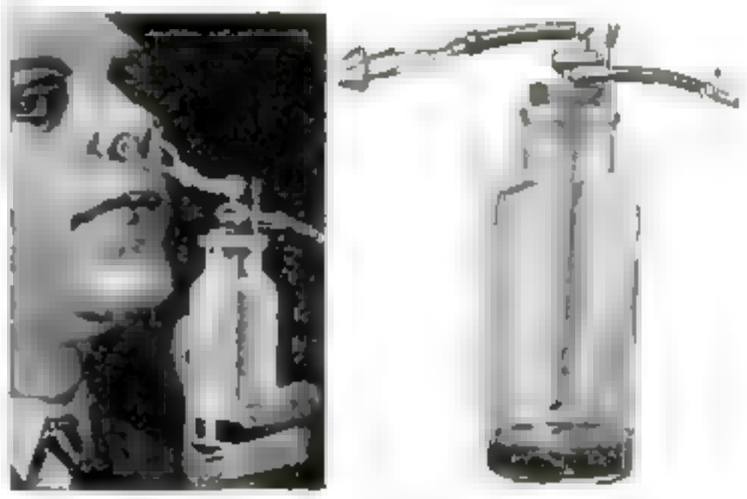
CONSTANTLY risking the danger of a fatal explosion, Prof. Percy W. Bridgman of Harvard University recently applied pressures up to 70,000 atmospheres—by far the highest ever produced by man—to nearly 200 elements and compounds. Nearly half of them assume amazing new forms. Rubber, paper, wood, and linen cloth turn into transparent, horn-like materials. Boiling water is transformed into a strange kind of ice that is even hotter. New apparatus makes possible the creation of these tremendous pressures.



Prof Stockbarger sawing a three-inch lithium fluoride crystal into sections for lenses. At left, lens "blanks"

CRYSTALS GROWN TO MAKE LENSES FOR INSTRUMENTS

A NEW lens-making material, superior to glass or quartz for many applications, has been perfected by Prof. Donald C. Stockbarger of the Massachusetts Institute of Technology. It consists of artifically grown crystals of a chemical called lithium fluoride, formed by placing the pure powder in platinum crucibles with conical bottoms and melting it in an electric furnace. As the material cools slowly, a tiny "seed" crystal forms in the point of the crucible, growing until the entire mass is one solid crystal. It may then be removed, cut to any desired shape, and polished. Transparent, optically perfect lenses have thus been obtained. Since the material transmits a wider range of ultra-violet light than any other known optical substance, photographic research instruments employing lenses made of it will be able to peer farther into secrets of matter.



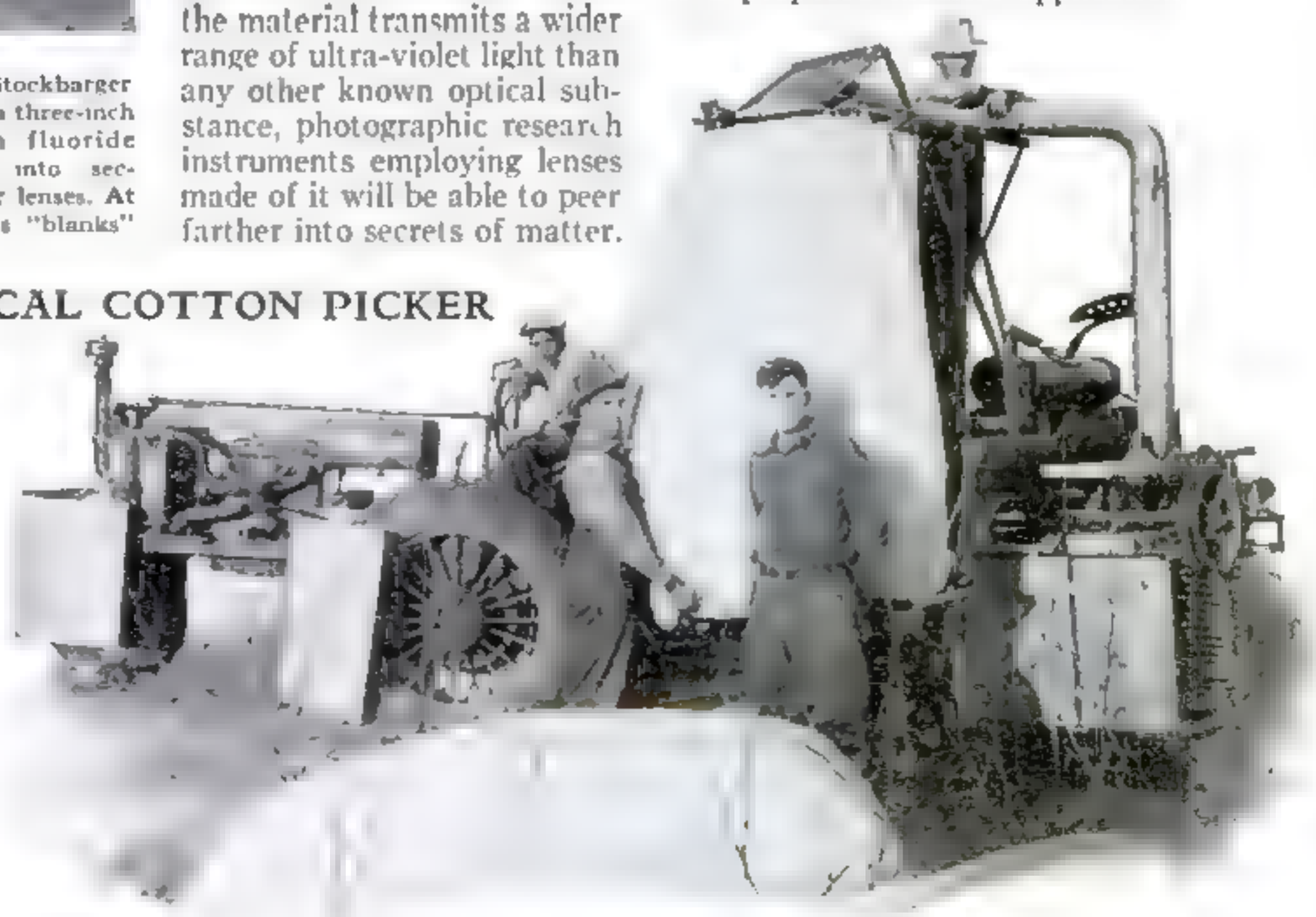
Subject testing his sense of smell with new scent meter, seen separately at the right

SCENT METER GAUGES KEENNESS OF SMELL

AN INSTRUMENT resembling a perfume atomizer, devised by a New York nerve specialist, accurately measures a person's keenness of smell. This is rated in terms of the amount of air that must be pumped up a subject's nostril, from a reservoir containing coffee or lemon oil, to produce a perceptible odor. Locating brain tumors is a proposed medical application

TEST IMPROVED MECHANICAL COTTON PICKER

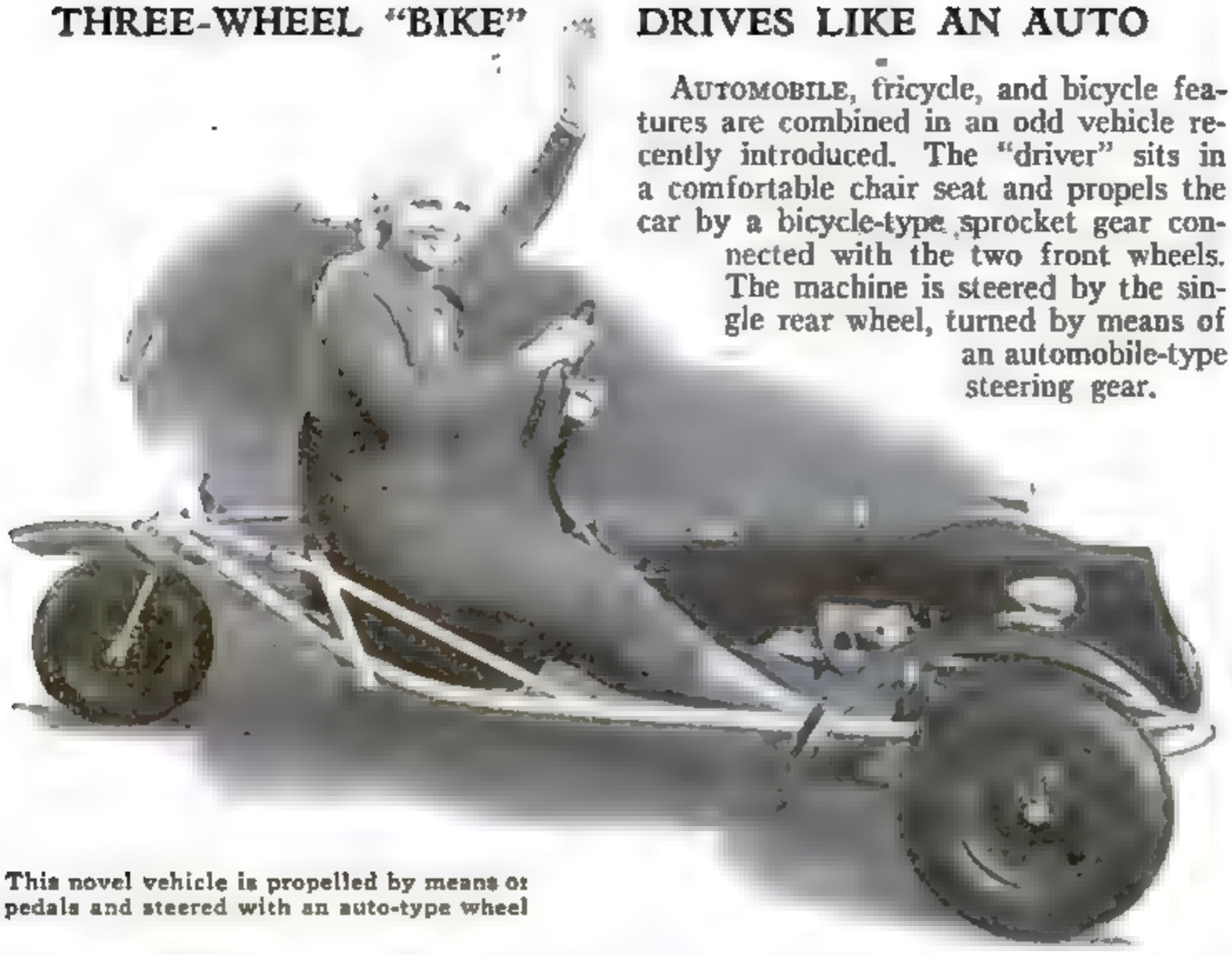
MACHINES may end the role of the traditional Negro cotton picker of the South, if current experiments to produce a practical labor-saving substitute prove successful. Witnesses of a recent Arizona demonstration saw the latest type of mechanical cotton picker harvest 600 pounds of cotton in three hours, while hand pickers near-by could gather only thirty pounds apiece in the same time. As the apparatus advanced, whirling claws stripped the fluffy white bolls from the plants, and a suction tube deposited them in a huge bag. The device is an improvement upon an original model that created a sensation when exhibited in Mississippi two years ago. Commercial production of the machines is expected soon.



This machine harvested 600 pounds of cotton in three hours—as much as twenty hand pickers

THREE-WHEEL "BIKE" DRIVES LIKE AN AUTO

AUTOMOBILE, tricycle, and bicycle features are combined in an odd vehicle recently introduced. The "driver" sits in a comfortable chair seat and propels the car by a bicycle-type sprocket gear connected with the two front wheels. The machine is steered by the single rear wheel, turned by means of an automobile-type steering gear.



This novel vehicle is propelled by means of pedals and steered with an auto-type wheel

Magnifier in use for examining fingerprints

EXAMINE FINGERPRINTS WITH ODD MAGNIFIER

TO SPEED up the checking of fingerprints, Pasadena, Cal., police use an odd enlarging machine. A light glowing in a metal chamber illuminates a fingerprint on an identification card. The image is enlarged and reflected upward through a funnel-shaped tube to a circular ground-glass screen at the top. By examining the magnified finger whorls and ridges projected upon the glass, police check large numbers of prints in a short time.

ICE CRYSTALS PRODUCE WEIRD EFFECT

Night photograph showing strange pillars of light said to be formed by reflection on tiny crystals of ice in the upper air. At the right are three such crystals, magnified forty times

MYSTERIOUS vertical pillars of light, sometimes extending more than 1,000 feet above street lights and airport beacons on cold, windless winter nights, are explained by Prof. B. W. Currie of the University of Saskatchewan, Canada. The displays, he finds, are caused by light reflected from minute ice crystals, formed in the upper air and settling toward the earth, which he has caught and photographed.

BABY CARRIAGE USES TRACTORLIKE TREAD

TO MAKE it easy to move a baby carriage up and down stairs, a new continuous-tread attachment is fastened underneath the body between the wheels. When the device is placed in the position shown in the photograph below, the carriage rides over steps with little effort on the part of the user, and without bumping. When not in use, the device is retracted close to the springs and clear of the wheels, where it does not interfere with ordinary operation.

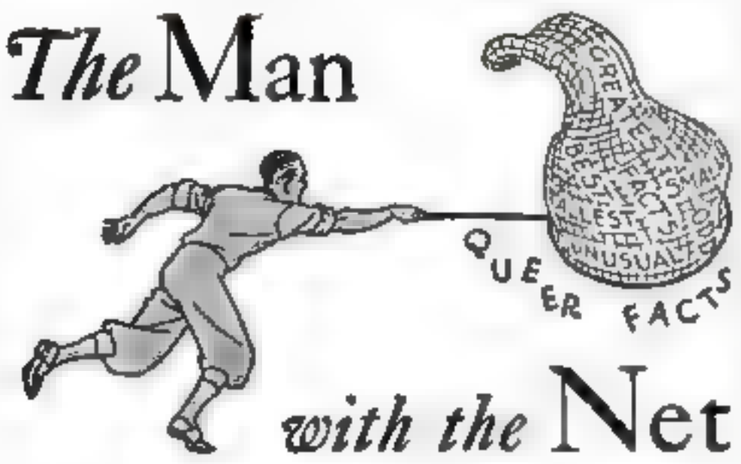
Poultrymen stamping identifying marks on the wings of chickens

TATTOO BRANDS ON FOWLS TO FOIL THIEVES

TATTOOING the wings of poultry with the brand of the owner is the novel method devised by the Connecticut Poultry Association to curb the activities of chicken thieves. The farmer inks a pair of specially devised tattoo pliers, adjusts them over the wing of a bird, closes the pliers, and a permanent identifying mark is stamped on the wing. Members who join the theft-control plan are given the necessary equipment, and their tattoo marks are registered with the state police.

Retractable tread helps baby carriage on stairs

The Man with the Net



RATTLESNAKES *can't hear their own rattles.*

NICOTINE *got its name from Jean Nicot, the man who introduced tobacco into France.*

PAINTED MUSHROOMS *are used as buttonhole flowers in France.*

FOURTEEN THOUSAND *average-sized ants will weigh one pound.*

WAX *keeps the fluids of the human body from evaporating.*

FORTY YEARS *without a drink of water is the record of John Eddy of Linton, Ind. Since 1895, he has confined himself to tea, coffee, and milk.*

ELEPHANTS *are near-sighted.*

A TOTAL *of 147 fires were set by electricity from the human body in the last six years.*

THUNDER *rolled in a record nineteen-minute peal not long ago in Kentucky. One clap was still sounding when the next began, so the reverberations continued without ceasing for the stretch of 1,140 seconds.*

EDIBLE PLATES *made from bread dough were exhibited recently at Chicago.*

GOAT WHISKERS *are used in making rugs and carpets.*

METEORS *hitting the earth in the past 100,000 years would form a layer, if evenly distributed over the surface of the globe, hardly one one-hundredth of an inch thick.*

SEVEN SNAKES *timed over level ground in California, had speeds of from a quarter of a mile an hour to three and a third miles an hour. The red racer was the fastest; the California boa the slowest.*

SMALLER BREEDS *of turkeys to fit smaller modern ovens are being sought by the U. S. Department of Agriculture.*

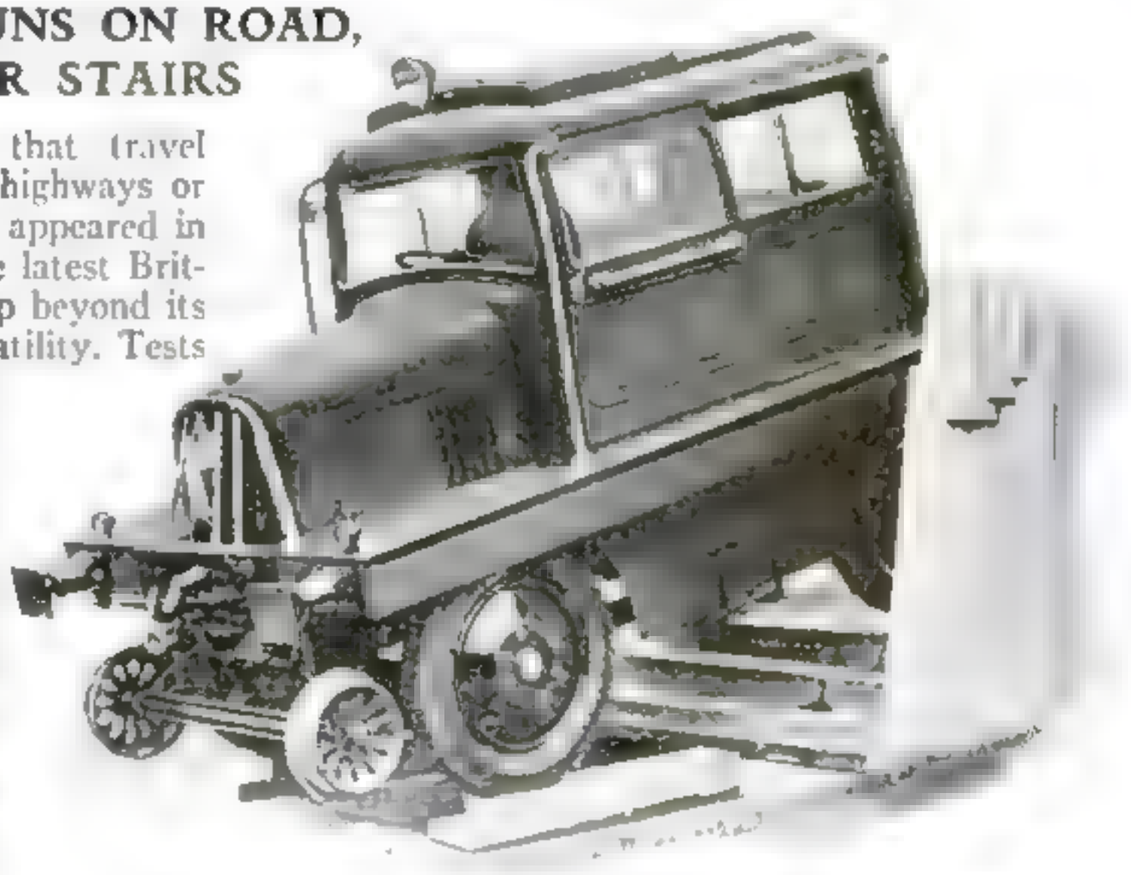
JUNGLE TOURISTS USE TREE-TOP HOTEL

From the veranda of this unique hotel, guests can watch jungle beasts

A HOTEL in a tree provides accommodations for sightseers in the heart of the African jungle near Nyeri, in Kenya Colony. Known as "Treetops," the establishment has two combination bed-and-sitting rooms and a bathroom, is equipped with electric lights, and is reached from the ground by a retractable ladder. It provides a safe retreat for the observation of wild animal life, which is attracted by salt licks near-by. The rate for one night's stay is ten pounds (about fifty dollars), a fee which includes transportation through the jungle to the hotel, native bearers to carry equipment and supplies, and an armed guard for safety.

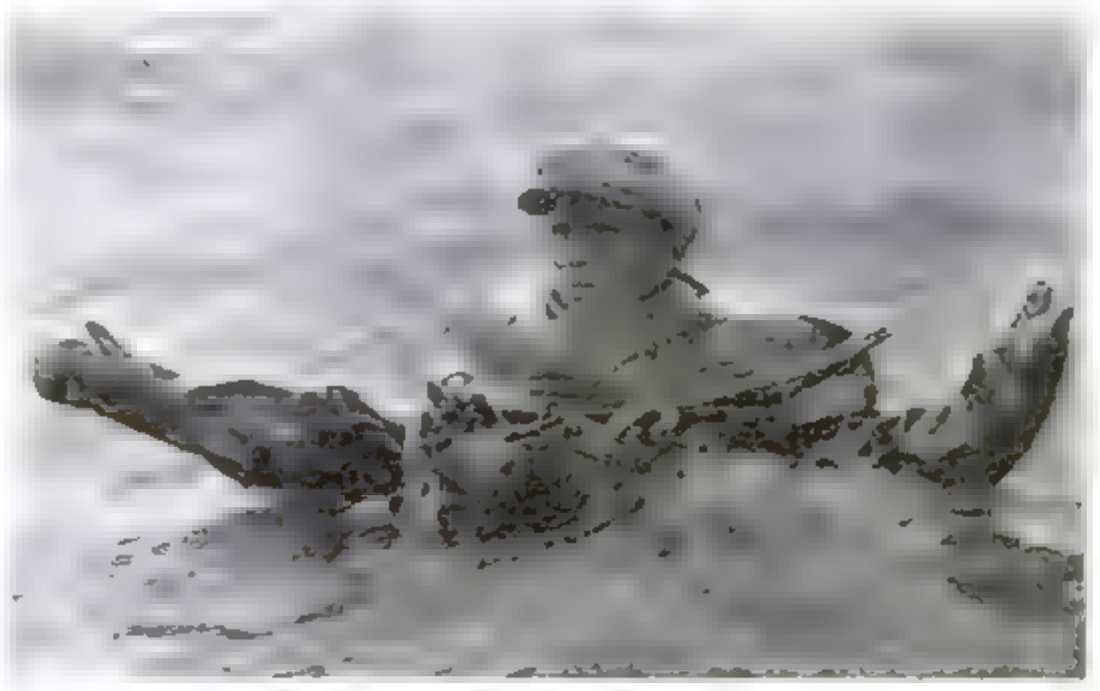
TRACTOR RUNS ON ROAD, RAILS, OR STAIRS

HYBRID vehicles that travel with equal ease on highways or railroad tracks have appeared in recent years, but the latest British model goes a step beyond its predecessors in versatility. Tests have demonstrated its ability to traverse rough unpaved ground and even to run up and down a flight of steps. For rail use, small, flanged wheels are lowered into place. A fifty-horsepower Diesel motor propels the machine, which has a four-wheel drive and can haul ten cars.



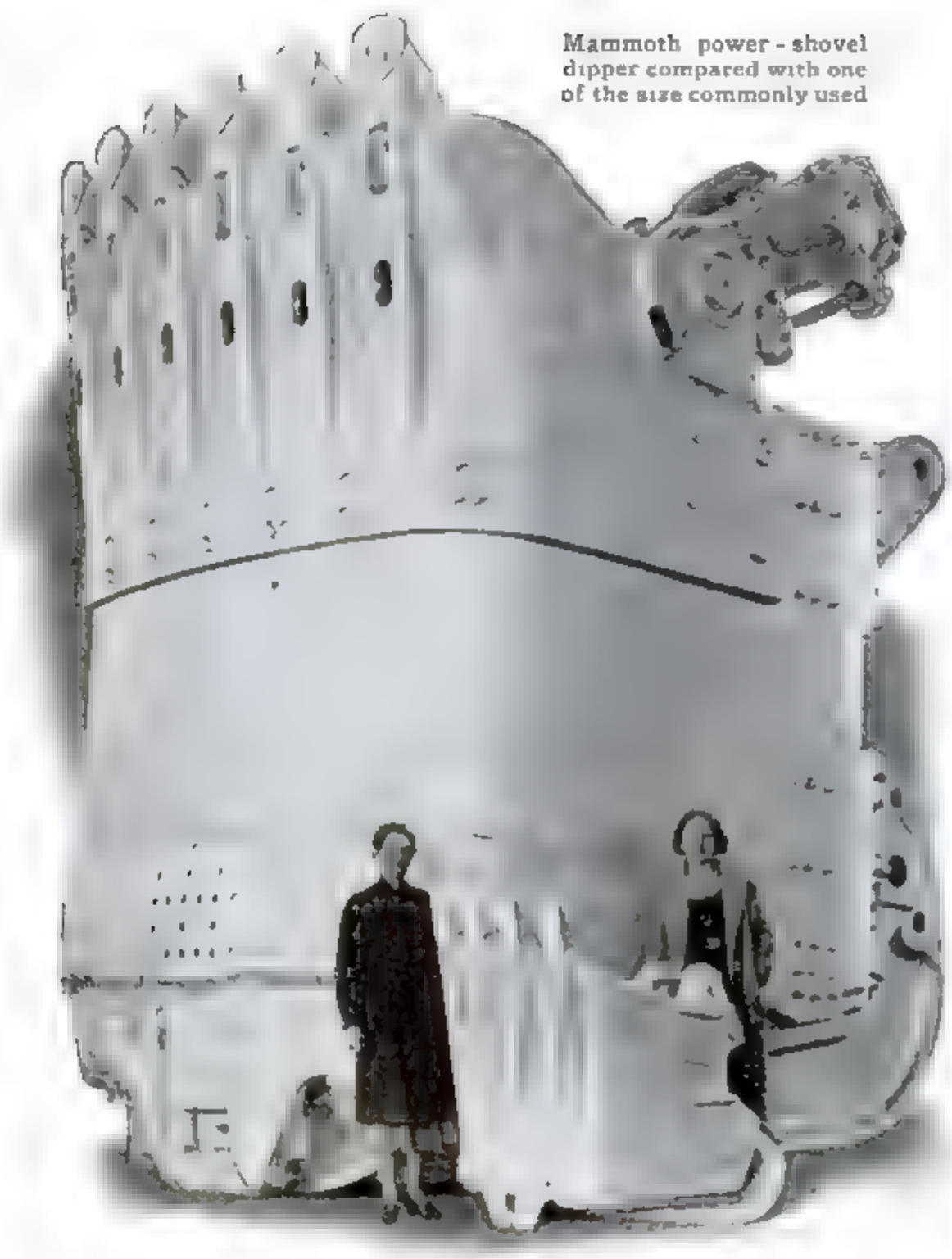
A British road-and-rail tractor crossing obstacles in a recent test

LIFE-SAVING SUIT KEEPS USER WARM



Comparative comfort is provided by this water-tight life-saving suit

WATER-TIGHT life-saving suits which keep the wearer afloat for two days, protect him from cold, and provide a compartment for food and water, may replace life preservers now in use. The suit is constructed of rubber, lined with kapok, and made water-tight by a rubber belt held against the neck. Lead weights keep the wearer upright.

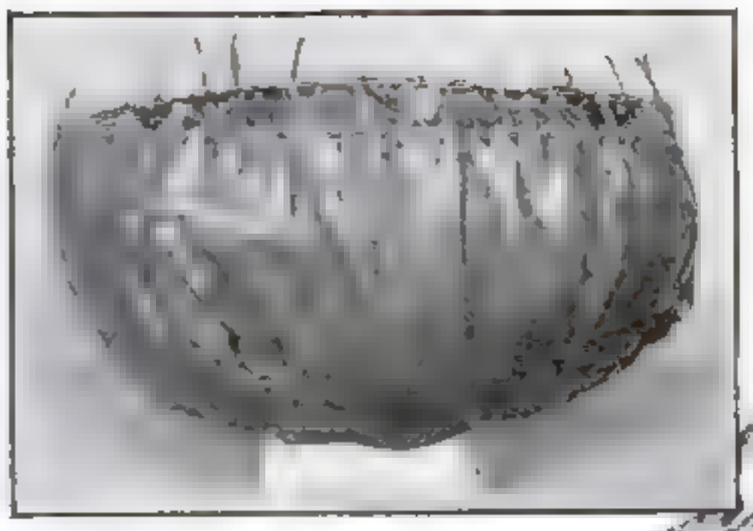


Mammoth power - shovel dipper compared with one of the size commonly used

BIGGEST DIPPER HOLDS HALF CARLOAD

Almost as large as the average one-car garage is a huge power-shovel dipper recently placed in operation at an Illinois coal mine. Made of a lightweight metal alloy, the mammoth bucket is said to be the largest of its kind in the world, having a capacity of thirty-two cubic yards. It could fill the average railroad car in two loads. The photograph shows the big dipper compared with a standard one of three fourths of a cubic yard capacity.

ODD TUBLIKE BOAT IS MADE OF SKINS



A coracle, or hide-covered boat, on display in a Chicago museum

Below, our artist shows how natives of Tibet cross rivers in these strange craft

TWIGS, skins, rawhide ropes, and butter are the materials used to make an odd tublike boat recently placed on exhibition in Chicago by the Field Museum of Natural History. Used by natives in Tibet to cross rivers, the curious craft is constructed around a framework of willow twigs. Skins are fastened around the "hull" and sewn together with rawhide strands. The holes made by stitching are calked with butter.

PAPER CLIPS GET MODERNISTIC SHAPE

Spiral-shaped paper clips, and one in use

PAPER CLIPS have appeared in a new "modernistic" design that is declared both decorative and practical. Because of their unusual spiral shape, according to the maker, they may be used repeatedly without losing their spring. Their thinness eliminates bulky files and cut envelopes.

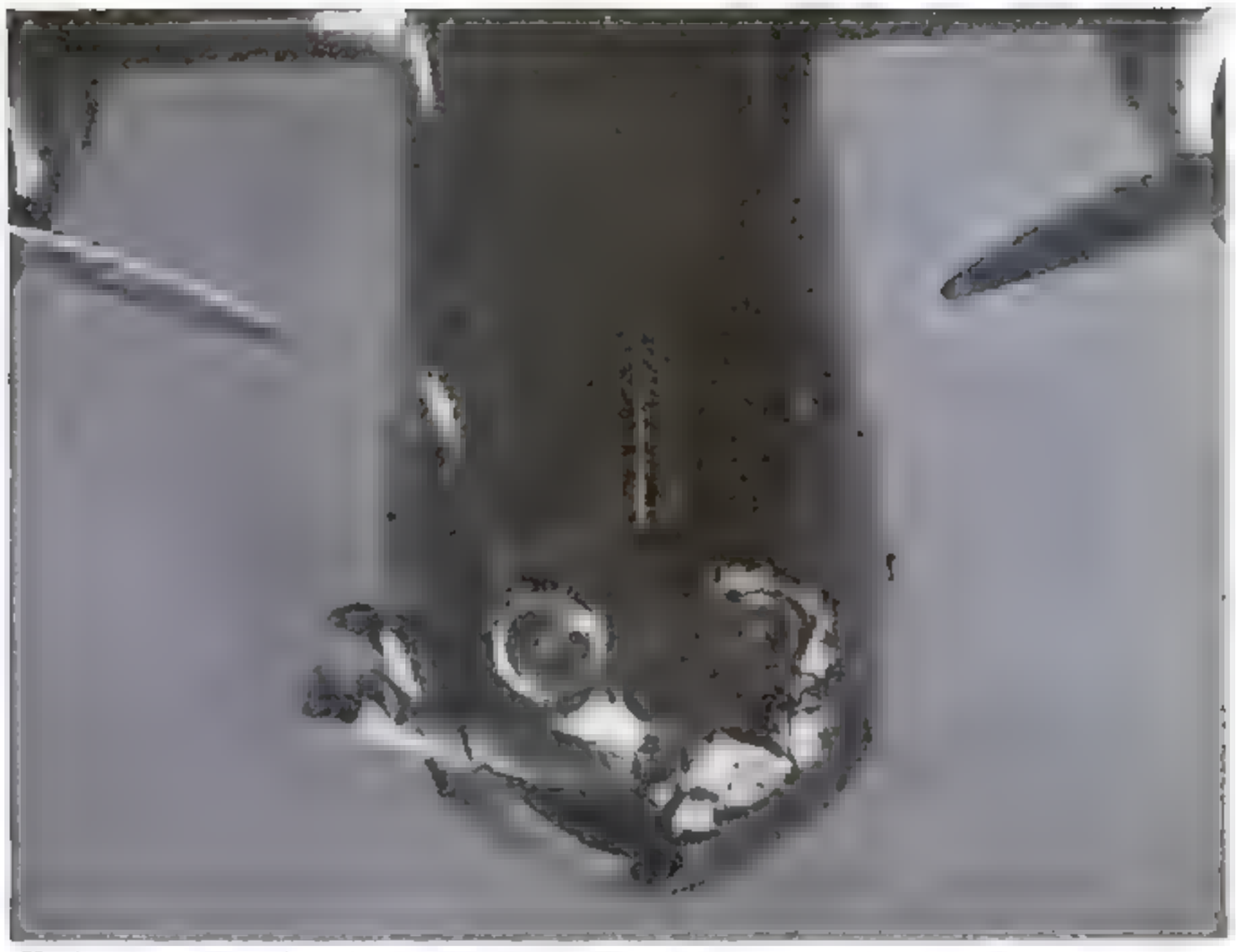
ELECTROLYTIC PROCESS TAKES GOLD FROM SEA

RECOVERING valuable radioactive substances from old radium-emanation tubes used for medical purposes is one application foreseen for a radically new electroplating process devised by Prof. Colin G. Fink, of Columbia University. His method, substituting a revolving, motor-driven cathode for the customary stationary one, performs electroplating feats hitherto considered impossible—among them the recovery of gold from sea water. The photo above shows him with his apparatus.

SALVE GROWS ROOTS ON PLANT STEMS

ENTIRELY new methods of plant propagation are forecast by the recent discovery of chemicals that cause roots to grow from the sides of the stems of plants. Scientists first discovered the curious effect a short time ago, and more than sixteen substances, most of them complex organic compounds, have been shown to produce the odd root growth. Where a salve incorporating chemicals of this type is applied directly to the stem of a tomato plant, numerous roots sprout from the spot in as short a time as six hours. These small roots, when replanted, are said to grow much more quickly than ordinary cuttings or seedlings. Other advantages claimed for this method of propagation include greatly reduced cost and absolute assurance that the healthy characteristics of the parent plant will be reproduced. Plants treated with the ointment are uninjured but grow into curious knotty shapes, for the stems curl up at the points where the ointment is applied. The substances which stimulate such growth have been named auxins.

A tomato plant being treated with chemical to produce root growth on its stem. Note resulting knotty formation at right. The inset shows small roots growing on a stem treated in this manner



Upside-down view of mechanic adjusting landing lights of transport plane gives weird effect

AIRPORT WHALE SWALLOWS A MODERN JONAH

A PICTURE that apparently shows a victim struggling in the jaws of a marine monster was the unlooked-for result when a photographer snapped a mechanic adjusting the landing lights of a big transport plane. The illusion is particularly striking when the photograph is viewed upside down, as shown at the left.

NAMES PRINTED ON FLOWERS

GIFTS of flowers that bear the name of the recipient are now possible, through a French method of printing lettering on living petals. A tin-foil stencil is placed over the flower, which is exposed to rays from an ultra-violet lamp, thus bleaching the coloring. The exposure may vary from ten seconds to as much as twenty minutes.

Red tulips marked with letters by new process

CRUDE RAILWAY CARRIES BOATS ACROSS CANADIAN PORTAGE

To SOLVE the problem of portaging outboard-motored skiffs from one lake to another, a narrow-gauge railroad has been placed in service at Prince Albert National Park, Canada. When a craft arrives at the end of a lake, it is hauled out of the water upon an incline, as shown in the lower view, and placed upon a flat car. With this aid, it is easily trundled through the wooded country to the next lake, as seen in the photograph above.

A power boat being hoisted from water to portage railway

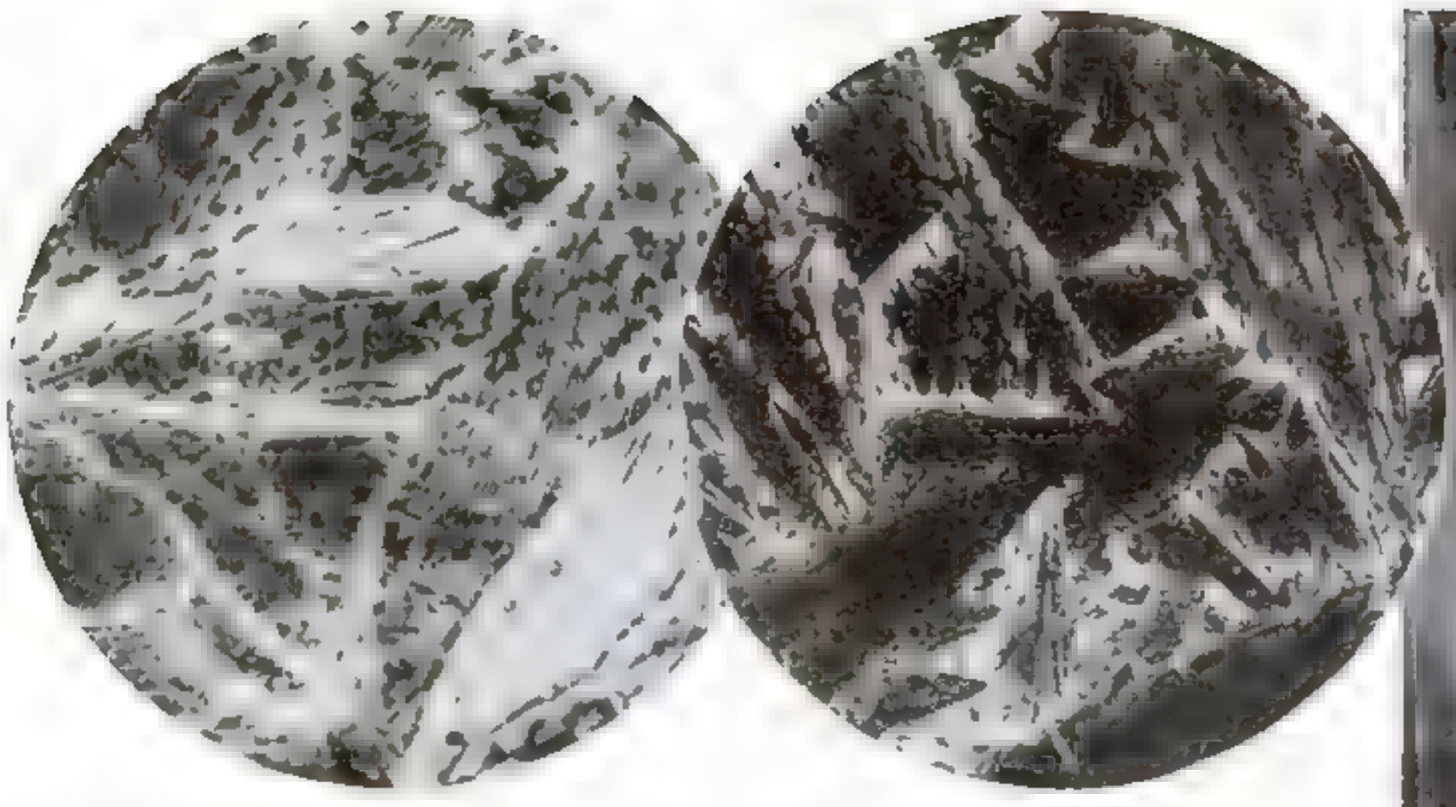
P. S. M. PLANS AID AMATEUR STARGAZERS

AIDED by POPULAR SCIENCE plans, George Rohrer and Howard Robinson, amateur astronomers of Atlantic City, N. J., have outfitted themselves completely for the pursuit of their hobby. The photograph shows them with their photographic telescope, sextant, spectroscope, and sky charts.

ROCKING BED EASES HEART STRAIN

SUFFERERS from heart ailments are said to be aided by a new rocking bed. Operated by an electric motor, the bed alternately raises the head and feet of the patient, helping the blood circulate to all parts of the body, thus easing the strain upon an over-taxed heart.

Alternately raising the head and feet, this rocking bed helps the blood to circulate



Crystals of two sulphates as seen through the microscope. At the left is magnesium sulphate (Epsom salts), and at the right, crystals of copper sulphate (blue vitriol). The photograph shows how the tilted microscope is used for watching crystals form

Strange Beauties of CRYSTALS

Revealed By Your Microscope

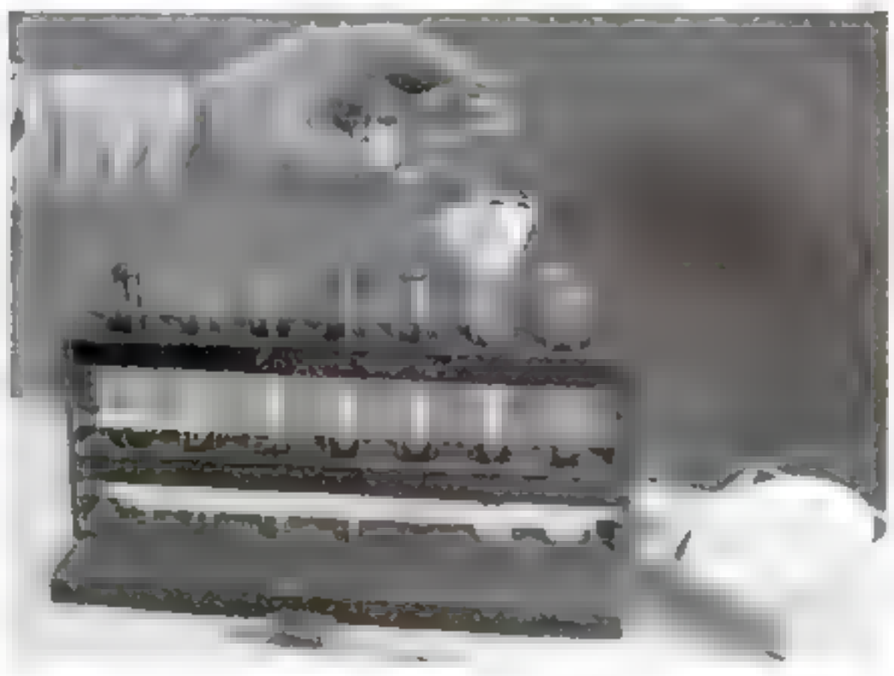
THIS is, in many respects, the age of crystals. The metallurgist, with his special microscopes, studies the crystalline structure of steels, and learns how to make better alloys. The microanalyst, by comparing minute crystals of a poison or a substance used to adulterate food, with known crystalline materials, is able to identify the undesirable ingredient. The science of microchemistry depends to a considerable extent upon knowledge of microscopic crystals. To the amateur microscopist, crystals have a special appeal because they are among the most interesting and beautiful objects upon which he can train his magic lenses.

A crystal is a piece of chemical element or compound whose surfaces are plane and arranged symmetrically. This arrangement is an outward expression of internal structure—in other words, of the manner in which atoms and molecules of the substance are placed. For convenience, crystals have been classified, according to their geometric form, into "systems." There are, for example, the hexagonal system, including such crystals as the elongated six-sided prisms of quartz; the regular system, represented by the octahedral (eight-sided) crystals of alum; the rhombic system, including sulphur and topaz crystals; the monoclinic system, of which gypsum crystals, tartaric acid, and rock candy are examples; the square prismatic system, with the mineral zircon as an example; and the trigonal system, with the scalenohedron crystal of calcite as an example.

But, without worrying about the countless possible crystalline forms, you can enjoy several evening sessions at your microscope, looking at crystals. The preparation of crystal specimens is so easy, and there are so many possible sources of interesting forms, that you need never want for an ample supply of varied materials.

From the kitchen table, borrow the salt shaker. Place a small pinch of salt on a clean glass slide, and add a few drops of water. Stir with a toothpick until the salt dissolves. Then warm the slide gently over a Bunsen burner, an alcohol lamp, or the small electric warmer whose construction is described later in this article. When the water begins to evaporate and a white deposit forms about the edge of the liquid, place the slide on the stage of your microscope, which has been tilted one or two degrees from the horizontal. Focus at the edge of the water film in the thinnest part of the water layer, and watch what happens!

You will see, here and there over the microscope field, tiny cubes that increase fairly rapidly in size. There may be groups of cubes that grow into masses resembling modernistic buildings. These cubical objects are crystals of sodium chloride—common salt. Scattered among them you may observe crystals that are not cubical in shape but which may have complex,

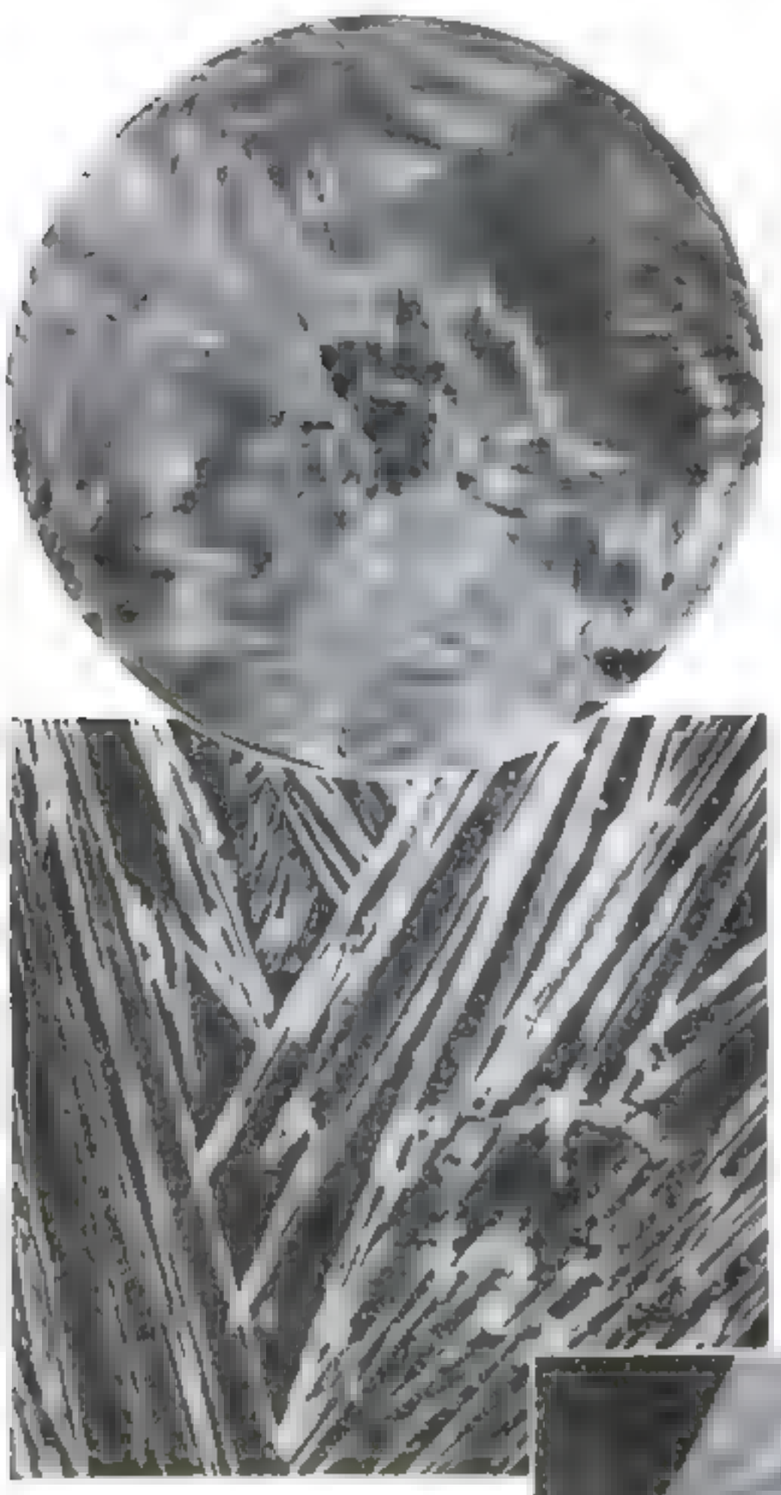


1 To prepare crystals of chemical salts for study under the microscope, make a saturated solution and filter it to remove dirt, lint, and other impurities

2 Place a drop of the filtered solution on a clean slide ready for evaporation into its crystals

many-sided forms. These are crystals of other materials, perhaps some iodine salts, that were present in the table salt.

By this simple method, you can prepare slides of hundreds of different water-soluble crystalline substances. The process almost invariably consists of making a saturated, or at least a strong, solution of the material either by adding a few drops of water to some of it on a clean slide, or by dissolving as much as possible in a small quantity of water, and then allowing some of the solution to evaporate and deposit crystals. Heat is applied mainly to hasten the process of evaporation.



In circle, mosaic of copper and magnesium sulphate crystals. Above, crystals of oxalic acid

The diamond-shaped object at the right is a rhombic sulphur crystal, magnified forty-five times

Tiny Particles of Common Household Chemicals, Viewed Through Your Magic Lenses, Present a Weird Wonderland for Exploration and Study

By Morton C. Walling

After you tire of looking at isolated crystals, try mixing two chemical salts together in solution, and letting the resulting liquid evaporate on a slide. Two excellent materials for this stunt are the sulphates of copper and magnesium. Make a saturated solution of copper sulphate (blue vitriol), and of magnesium sulphate (Epsom salts). Mix a drop of each solution together on a glass slide and heat to a fairly high temperature. The salts will fuse in their water of crystallization. Do not carry the heating too far. Stop when the material has formed a clear film on the hot glass.

Transfer the warm slide to the microscope, and focus on the film. Adjust the illumination so that the light is not too strong; or, better still, employ dark-field illumination if your microscope is equipped for that. As the film cools, you will see little points appear and spread out in a beautiful pattern. You often can start these points by touching the film with the point of a needle. The growing patterns eventually run into each other, at which time growth stops. The result is a crystalline mosaic that is best seen at fifteen or twenty diameters. Sometimes, rainbow colors are visible in the intricate patterns.

Various other stunts can be performed with some of the common salts. By allowing a copper sulphate solution to crystallize at fairly high temperatures, around ninety degrees, interesting spiral patterns can be produced. By adding a little colloidal silica to solutions of metallic salts, many fascinating spiral and curved patterns are formed by the crystals. The solution should contain about three or four percent of colloidal silica, according to some microscopists. Commercial water glass (sodium silicate), sold for use as an egg preservative, contains a considerable amount of colloidal silica.

Water is not always the solvent employed for making solutions from which crystals grow upon evaporation. Sulphur, for instance, is insoluble in water but dissolves readily in carbon disulphide. There are two crystalline forms of sulphur, the monoclinic and rhombic. Melt a quantity of sulphur in a small crucible—a small tin can will do—being careful not to let it catch fire. If it does, smother the flames by placing a piece of cardboard over the container. Fumes of burning sulphur are irritating and, in sufficient quantities, poisonous. When the sulphur has become liquid, set the container aside to cool. After part of the sulphur has solidified, pour out the liquid center. This will reveal a mass of long, slender, pale-yellow crystals of monoclinic sulphur. In time, at ordinary temperatures, these will turn to masses of rhombic sulphur.

THERE is a quicker method of producing rhombic sulphur crystals. Dissolve some sulphur in carbon disulphide, pour a few drops of the solution on a glass slide, and let the solvent evaporate. Scattered rhombic crystals of varying sizes will result. At fifteen or so diameters, these are very beautiful. In handling carbon disulphide, keep it away from fire, as it is highly inflammable and explosive.

In your study of crystals, you will find that, while each substance that crystallizes does so in accordance with a definite plan or pattern—a fact that is of value in recognizing unknown materials—the final crystalline pattern may not always be the same for each material. You can demonstrate this with a solution of common salt.

Place a drop on a slide and heat it gently. Soon the water at the edge of the drop will evaporate, and the solid material will be visible as a ringlike deposit. Sometimes, masses of crystals will grow out from this ring with amazing rapidity, soon covering the *(Continued on page 112)*

3 Drive off water by heating the slide gently. The heater shown in the illustration is the resistance unit described. The transformer is in the background

4 To protect a crystallized chemical from moisture, place a drop of castor oil over it and set a clean cover glass on top of it

5 For permanent preservation, seal the castor-oil mount by applying gold size in a ring around the edge of the cover glass

Scientific Stunts

FOR THE HOME EXPERIMENTER

TOY BALLOON FINDS HEAT LEVEL

Filled with gas and carefully weighted with cardboard, a toy balloon released in an artificially heated room will drift about just level with the tops of the doorways. This is because the warm air near the ceiling is lighter than the balloon, which therefore floats on top of the layer of cooler and denser air below. The effect is very striking

EARTH'S MAGNETISM DIPS NEEDLE

Tie a thread to the middle of a steel knitting needle so that it hangs horizontally, then magnetize it by stroking with a permanent magnet. If suspended as shown below, it will dip at the end pointing to the north, if you are in the Northern Hemisphere, to follow the earth's magnetic lines of force

RADIUM RAYS PENETRATE HEAVY PAPER

The rays from the radium on your luminous watch dial have penetrating power like X rays. Wrap a photographic plate or a piece of film in heavy black paper and place the watch dial next to the paper. In thirty-six hours the rays will make an impression on the film, as shown in the photograph at the right

RADIUM ON YOUR WATCH DIAL

In a dark room, look at the luminous numerals on your watch dial with a strong magnifying glass, and you will see what happens when radium atoms break down. You will see the luminous areas flashing with hundreds of twinkling lights, looking like microscopic fireworks. Each flash indicates that an atom of helium, shot out by the disintegrating radium, has collided with a crystal of zinc sulphide. The luminous paint contains a minute quantity of radium, or a radioactive substance, and the sulphide of zinc

GLASS SHOWS WAVE LENGTH OF LIGHT

Heat the sealed end of a glass tube until it is red hot and blow into a thin bubble as below. If parts of it show colors in a thin film, the thickness of the glass is close to the length of light waves, or about one forty-thousandth of an inch. When broken, the glass will float like thistledown

ULTRASENSITIVE BAROMETER

With a vacuum bottle and a piece of small glass tubing, you can show a difference in air pressure for a six-inch change in elevation. The tube, bent horizontal to eliminate the effect of gravity, passes through a hole in an air-tight cork. A drop of water in the horizontal tube moves as the elevation of the bottle changes

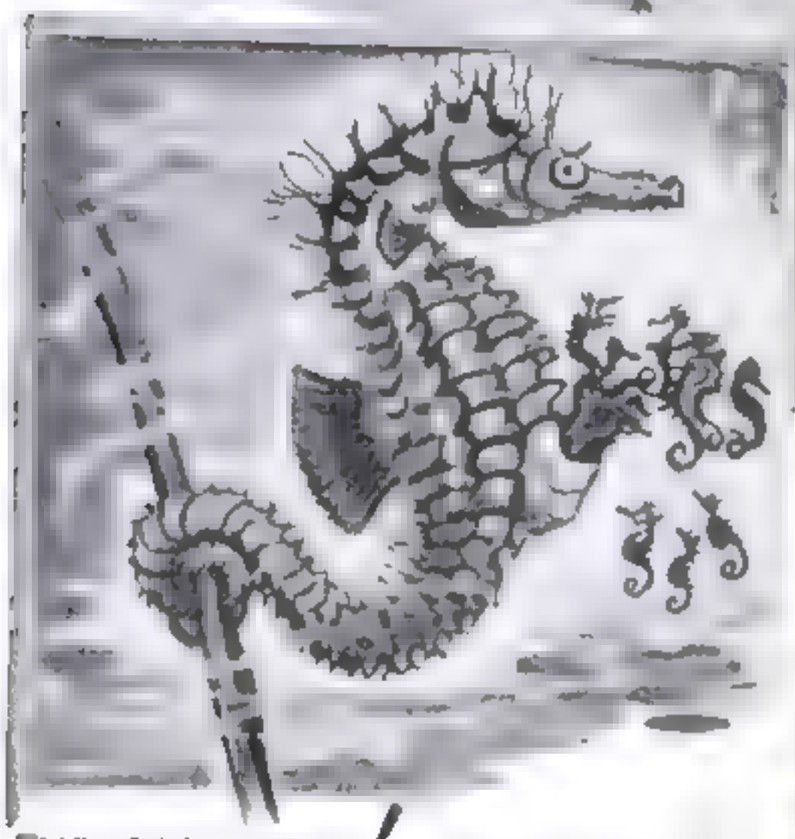
MAGNET ATTRACTS PLATING

There is not enough nickel plating on a brass safety pin for a magnet to pick it up, but when suspended by a thread, as at left, the pin is easily attracted. It is also possible to magnetize the plating

Un-Natural History

By GUS MAGER

THE POLAR BEAR'S SMALL, WEASEL-LIKE HEAD, LONG, SLENDER NECK, AND BRISTLE-SOLED FEET MAKE HIM A FREAK AMONG ALL OTHER BEARS! YES, HE WEARS STIFF-HAIRED BRUSHES ON THE SOLES OF HIS PAWS, TO GIVE HIM A FOOTHOLD ON THE SLIPPERY ICE!



THE SEA HORSE! THE FISH WITH A HORSE'S HEAD AND A MONKEY'S TAIL. BUT WHAT A SISSY NATURE HAS MADE OF PAPA SEA HORSE! DADDY SEA HORSE IS A LIVING BABY CARRIAGE. HE HAS A POUCH IN HIS ABDOMEN, IN WHICH MAMMA SEA HORSE LAYS HER EGGS, AND IN WHICH PA CARRIES THEM UNTIL THEY ARE HATCHED — IMAGINE!

AND THIS CUTE LITTLE ORNAMENTAL BUNCH OF GREEN FEATHERS— TAKE IT OR LEAVE IT— IS A CATERPILLAR FROM THE TROPICAL JUNGLES OF BORNEO!

THE NATURAL WAY FOR MOST PARENT BIRDS TO FEED THEIR YOUNG IS TO PUSH THE BEAK DOWN THE YOUNG BIRDS' THROATS, BUT THE PELICAN FEEDS ITS FLEDGLINGS JUST THE REVERSE — HE OPENS HIS GULLET CAFETERIA, AND THE YOUNGSTERS REACH FAR INTO THE THROAT AND HELP THEMSELVES TO THE FISHY FREE LUNCH, SWALLOWING THE FOOD BEFORE WITHDRAWING THEIR HEADS

THE SQUID HAS FOR COUNTLESS AGES USED A "SMOKE SCREEN." IT EJECTS AN INKY FLUID TO HIDE ITSELF AND BAFFLE ITS ENEMIES OF THE BRINY DEEP!

IT DOES appear sometimes as though Old Mother Nature couldn't keep score—as though she were still playing with blocks. Her department seems gummed up, and not at all in apple-pie order, as witness her thousands of apparently unnatural mutations and variations. Just look at the haywire creatures of many kinds assembled on this page.

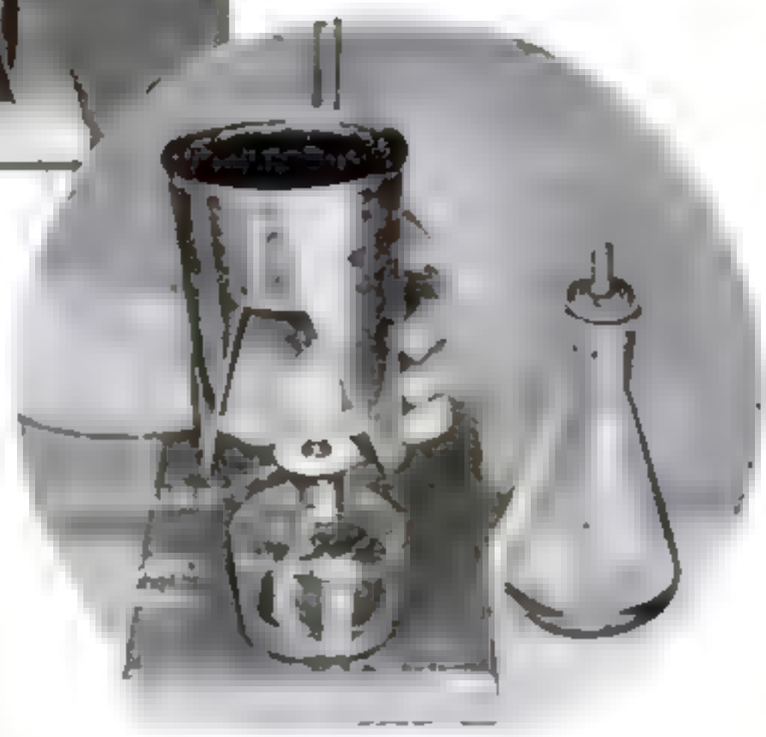
Chemistry Equipment

Bottles, Tubes, and Other Objects Found in Every Household Can Be Made into Apparatus For Performing Many Fascinating Experiments

By Raymond B. Wailes

PROOF THAT AMMONIA GAS WILL BURN

When a solution of ammonium hydroxide is heated gently in a flask, ammonia gas is released. A lighted match held to the outlet of the flask ignites the gas as it breaks down into nitrogen and hydrogen, the latter burning. The heater illustrated is an alcohol lamp fitted with a shield made from a can, as shown below



"I WISH I had a chemical laboratory, but I can't afford it," more than one would-be home experimenter has told me. They share the popular idea that chemistry is necessarily an expensive hobby.

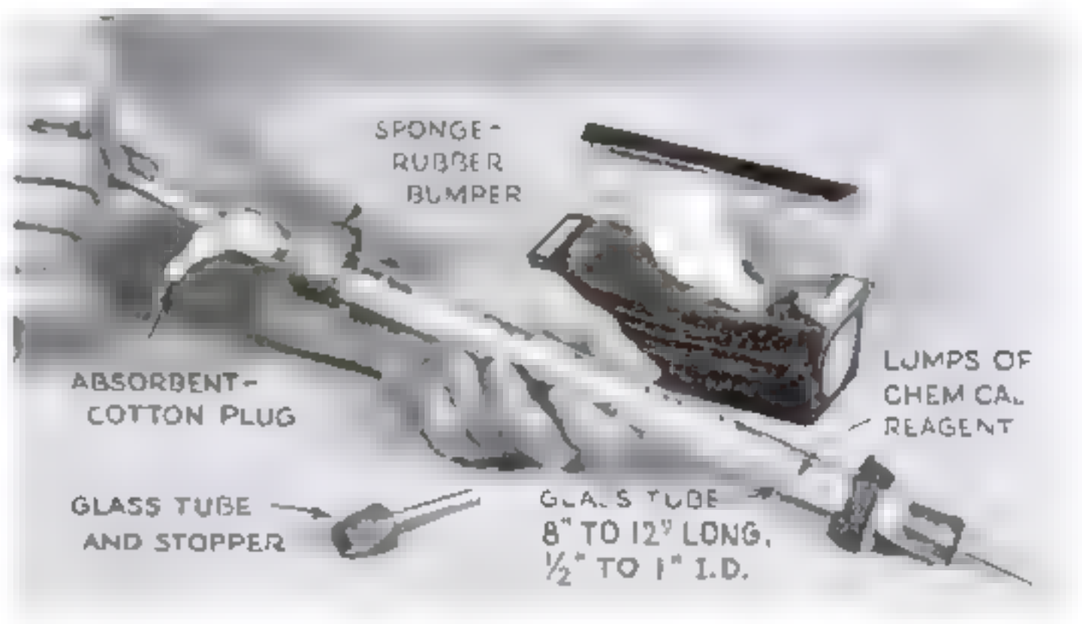
It needn't be. Naturally, it is sensible to enjoy the convenience of the fine equipment that supply houses can provide, if you have the money to spend for it. You might be surprised, however, if your purse is limited, to discover how much of the apparatus you need can be assembled at little or no cost from odds and ends. Perhaps it may not be as professional-looking as some that you have seen, but it works, and that is the main thing you are interested in. Later on, if your finances allow you to add more costly pieces of ready-made equipment, the experience you have already had with inexpensive homemade apparatus will guide you in making wise selections.

Your own home will yield a variety of objects that can readily be transformed into useful laboratory accessories. Bottles of every description are treasure trove, for they may be cut apart, by methods described in previous articles of this series, and used to make all sorts of apparatus—funnels, crystallizing dishes, pneumatic troughs, condensers, drying tubes or towers, and reaction chambers. Discarded or broken glass "straws," the kind used for sipping beverages, make useful tubes for conducting liquids and gases. Corks of all kinds, and odd lengths of rubber tubing, are worth-while finds for an amateur chemist ransacking the household cupboards. Even unlikely looking objects are not to be passed over too hurriedly—a pair of letter scales, for example, may come in handy for weighing out chemicals.

To store your supply of chemicals, you will need an array of small, neatly labeled vials or bottles. Wide-mouthed bottles should be used for solids, and small mayonnaise jars will serve the purpose. Wash the inner lining of waxed cardboard, under the metal cap; but do not discard it, for many chemicals would attack the bare metal. Small-mouthed bottles are preferable for keeping liquids. Ordinary corks may be used for bottles containing substances that do not attack cork. Glass-stoppered bottles will be needed for ammonium hydroxide, iodine in crystals or alcoholic solution, bleaching powder, and the acids. Lye, or sodium hydroxide, cannot be kept in even a glass-stoppered bottle, for the stopper will stick; a rubber stopper should therefore be used, or a bottle may be fitted with a cork that has been weighted and soaked in molten paraffin.

A raid on the kitchen and the family medicine chest will help fill your bottles with chemicals, if you can identify the ones you find there under their various aliases. The baking soda on the kitchen shelf is sodium bicarbonate, while sodium carbonate can be recognized as washing soda or sal soda. Epsom salts provide magnesium sulphate. Bleaching powder, sometimes labeled chloride of lime, contains calcium hypochlorite. Lye supplies you with sodium hydroxide, alum with potassium aluminum sulphate, and sal ammonia with ammonium chloride. Table salt consists principally of sodium chloride. Vinegar, which contains acetic acid, can be pressed into service when a very weak acid is needed for chemical experiments. Precipitated chalk is a form of calcium carbonate. Familiar chemicals that travel under their right names include sulphur, charcoal, boric (or boracic) acid, carbon tetrachloride, and denatured alcohol. Ammonia water, or household ammonia, is ammonium hydroxide; while the commercial form is not a pure one, it may nevertheless be used successfully in many chemical experiments.

A very strong and pure solution of am-



A DRYING TUBE

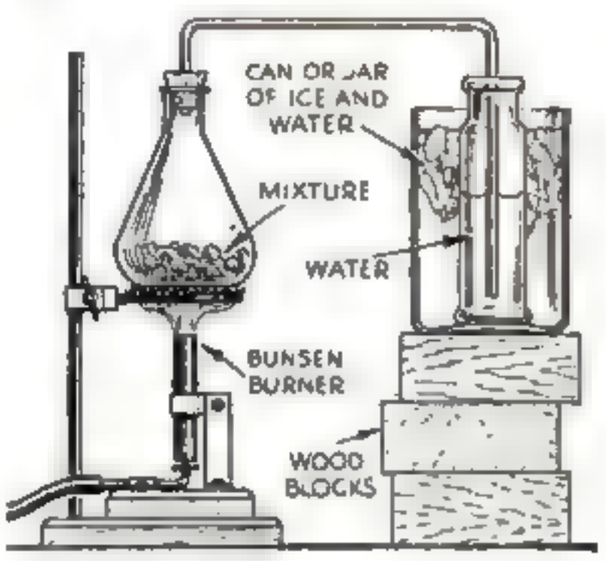
To remove water vapor from gases generated in the laboratory, you can make this simple drying tube. Lumps of desiccated (anhydrous) calcium chloride are used to provide the drying action

from Odds and Ends

monium hydroxide, if needed, is easy to make. When ammonia gas is bubbled through water, it dissolves, combining with the water to form ammonium hydroxide. Ammonia gas for this purpose may be generated by heating an alkali and an ammonium salt in a flask with a small amount of water. Ordinary household lye, or sodium hydroxide, will serve for the alkali. The ammonium salt may be either ammonium sulphate or ammonium chloride; both are readily obtainable and very inexpensive.

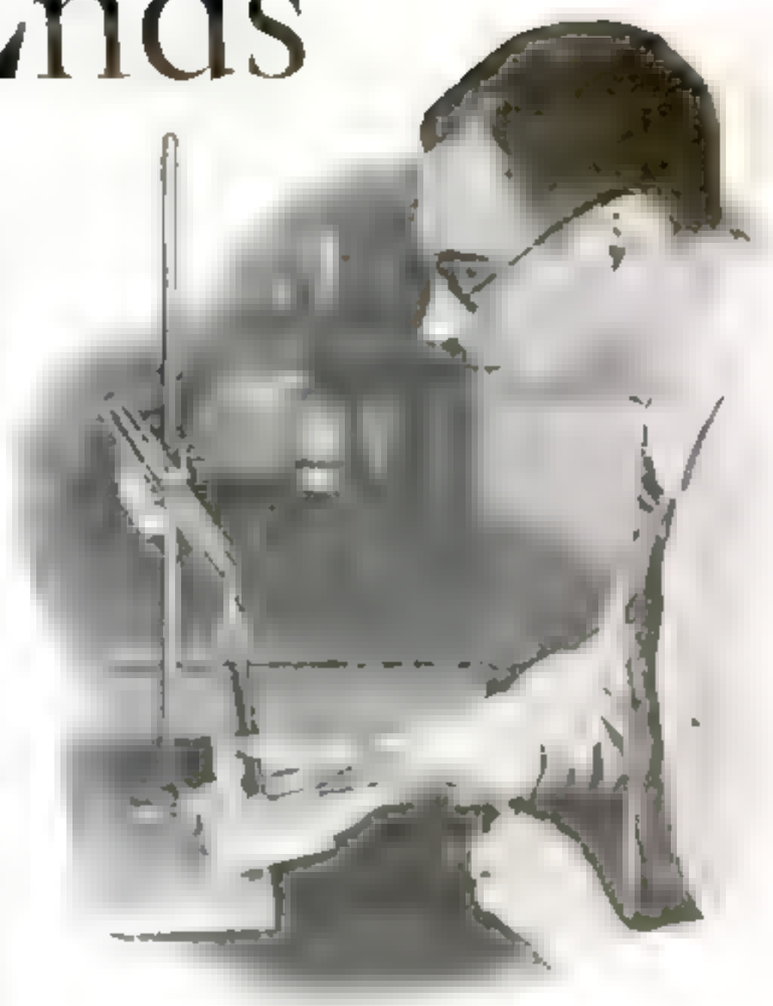
The ammonia generating flask in which these substances are placed should be fitted with a one-hole stopper. A glass tube leads the gas to an outlet under water in a narrow vessel, such as an olive bottle. Keep the water cold, by standing the bottle in a can or jar of water and ice, as the formation of a strong solution would otherwise be impeded by the heat developed as the ammonia gas dissolves in the liquid.

Heat the flask, and you will observe that copious quantities of ammonia gas are produced. Bubbles coming from the outlet tube disappear in the water at the start, however, because the gas dissolves completely. The water in the bottle is well saturated with the gas when a strong odor of ammonia is produced by bubbles escaping from the liquid. At this point, you may remove the bottle and substitute another of fresh water, if more of the solution is desired. Wooden blocks will serve as a rest for the bottles, and may be slipped out when a bottle is to be changed.



Apparatus for preparing ammonium hydroxide. Gas generated in the flask is dissolved in water in the bottle

Either an ammonium hydroxide solution prepared in this way, or ordinary household ammonia, may be used to demonstrate that ammonia gas will burn. Place whichever solution you choose in a flask that is fitted with a one-hole stopper, and heat it cautiously. This releases the ammonia gas. If a glass tube is placed in the cork, a lighted match held at its upper end will kindle the escaping vapors. The ammonia breaks down into the substances of which it is composed, nitrogen and hydrogen, and the latter burns.



Chlorine gas, produced by heating a mixture of match heads and acid, is made to bleach wood

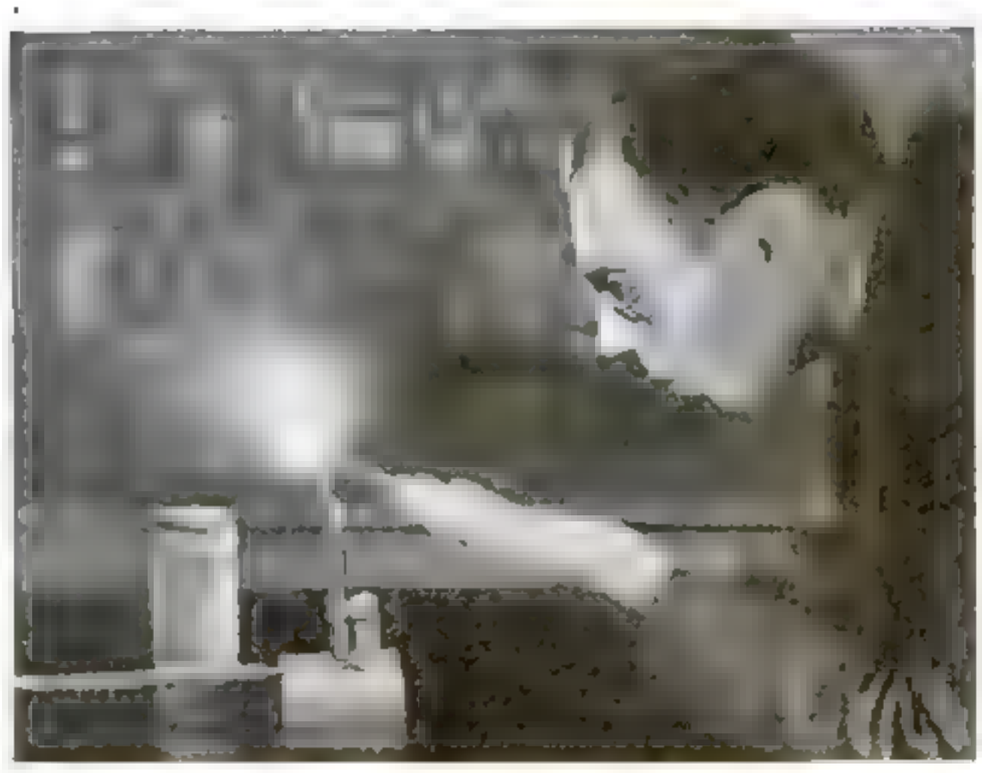
The solution used in this experiment should be heated very gently, especially when household *(Continued on page 125)*

Chemical MAGIC with Zinc

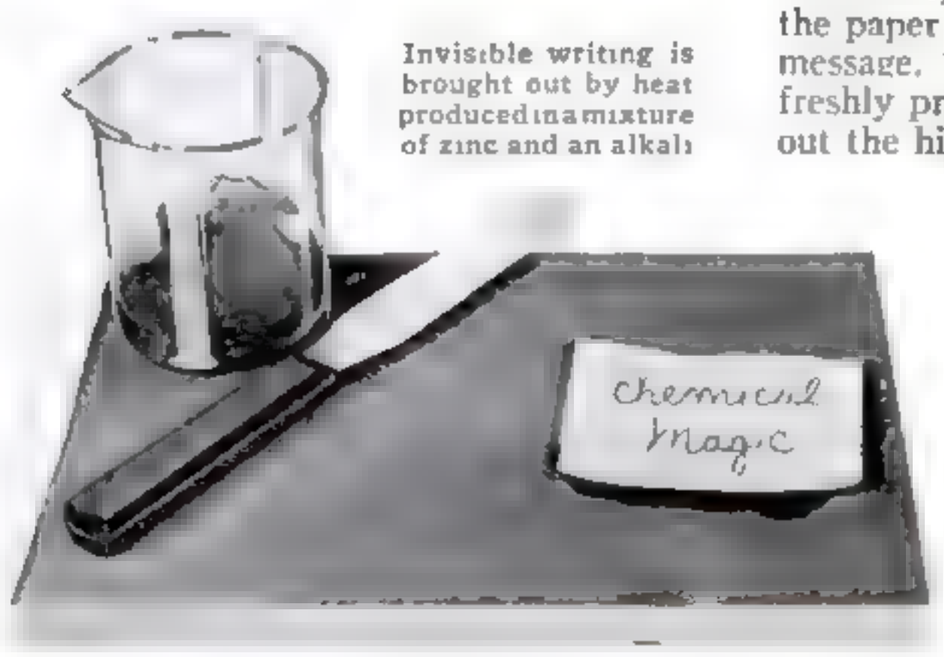
ENTERTAINING stunts of chemical magic can be performed with zinc in finely powdered form, which may be purchased from dealers in chemicals as "zinc dust."

A composition that takes fire spontaneously may be made by mixing the metallic powder with sodium hydroxide solution to form a paste. The exact strength of the last-named ingredient does not matter a great deal, but a ten-percent solution that is sure to be satisfactory can be made by dissolving about ten grams (two teaspoonfuls) of sodium hydroxide or lye in ninety to ninety-five cubic centimeters of water (an ordinary drinking glass holds about 240 cubic centimeters). Squeeze the zinc-alkali paste between sheets of stiff, absorbent paper to remove the excess sodium hydroxide solution, and then spread it out in a layer about one fourth of an inch thick. Within one or two minutes, of its own accord, the paste will steam, smoke, and finally catch fire, forming white clouds of zinc oxide as it burns.

Write some words upon a small square of paper, using a clean pen and employing a solution of a cobalt chemical—cobalt chloride dissolved in water, for instance—as ink. When the writing is dry, it will be invisible. Now prepare a layer of alkali-dampened zinc dust, as before, and lay upon it the paper with the invisible message. The heat from the freshly prepared paste develops or brings out the hidden writing.



Ordinary zinc stearate powder, blown into the flame of a Bunsen burner, produces a vivid, spectacular flash of light



Invisible writing is brought out by heat produced in a mixture of zinc and an alkali

The explanation of the paste's mysterious behavior is threefold. The alkali first dissolves some of the zinc oxide that is always present in zinc dust. The zinc itself also reacts with the alkali, as well as with the oxygen of the air. Each one of this series of reactions liberates heat, and their combined effect raises the temperature of the paste until the zinc metal actually takes fire and burns at the expense of the oxygen in the air. The paste should be spread on a surface that will not conduct heat rapidly.

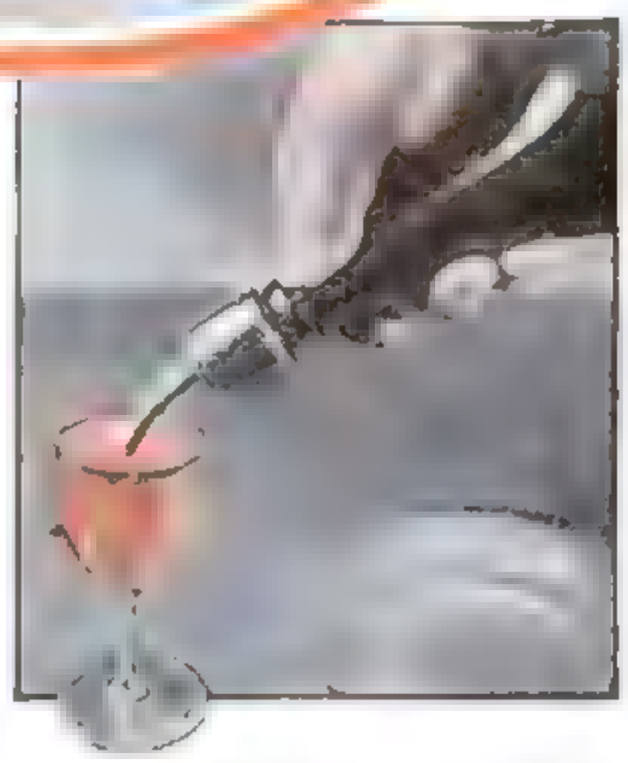
Another way you can make zinc burn is to take a pinch of zinc dust in the palm of your hand, or place it in a small tube, and blow it into a flame. Its rapid combustion produces a vivid flash of light. Ordinary zinc stearate powder, found in many household medicine chests, can be used instead. In this case, the sound accompanying the flash, a harmless "woof," makes the demonstration still more impressive.

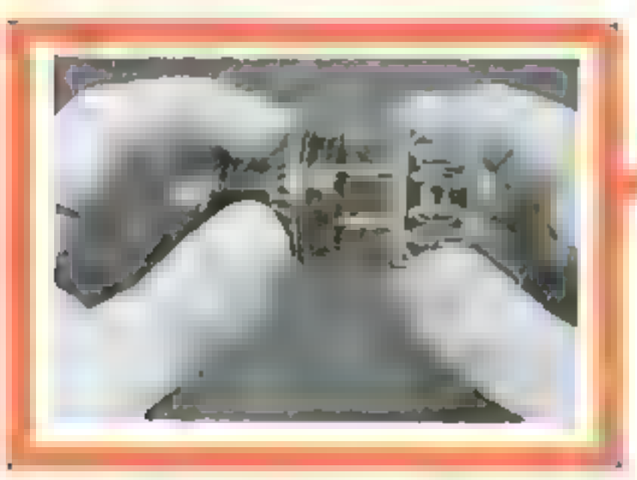
COMFORT AND CONVENIENCE FEATURED IN

New Appliances *for the* Home

SHAVING STAND. Mounted on a heavy base, this metal stand holds everything needed in shaving. A built-in light below the mirror receives power through an extension cord running from the base. There is a brush holder with cup, and a tray for razor and soap. The height is adjustable

WINDOW SHELVES. Narrow window sills can be put to use by means of portable shelves which are easily put in place. They are nine inches wide and come in a choice of three different lengths





End view of continuous outlet strip, to show its construction

CONVENIENT OUTLETS for electrical appliances are provided at six-inch intervals on a continuous molding strip. The material is available in various lengths and is easily installed

DRIPLESS BOTTLE SPOUT. When the tip of this "magic spout" is dipped into the liquid already poured, as shown, the flow is stopped and the spout can be withdrawn without spilling. It can be used on wine and other liquor bottles

An exact "jiggerful" of liquor is drawn from a bottle when the rubber bulb on this new highball-mixing aid is pressed as illustrated above

THREAD RETAINER. The metal clip shown above keeps thread from slipping off the spool. Thread feeds through an eyelet that moves across the spool in a transverse slot

TESTS COFFEE FRESHNESS
To enable the housewife to test the freshness of vacuum-packed coffee, a manufacturer supplies a chemically impregnated label that changes color when in contact with oxygen

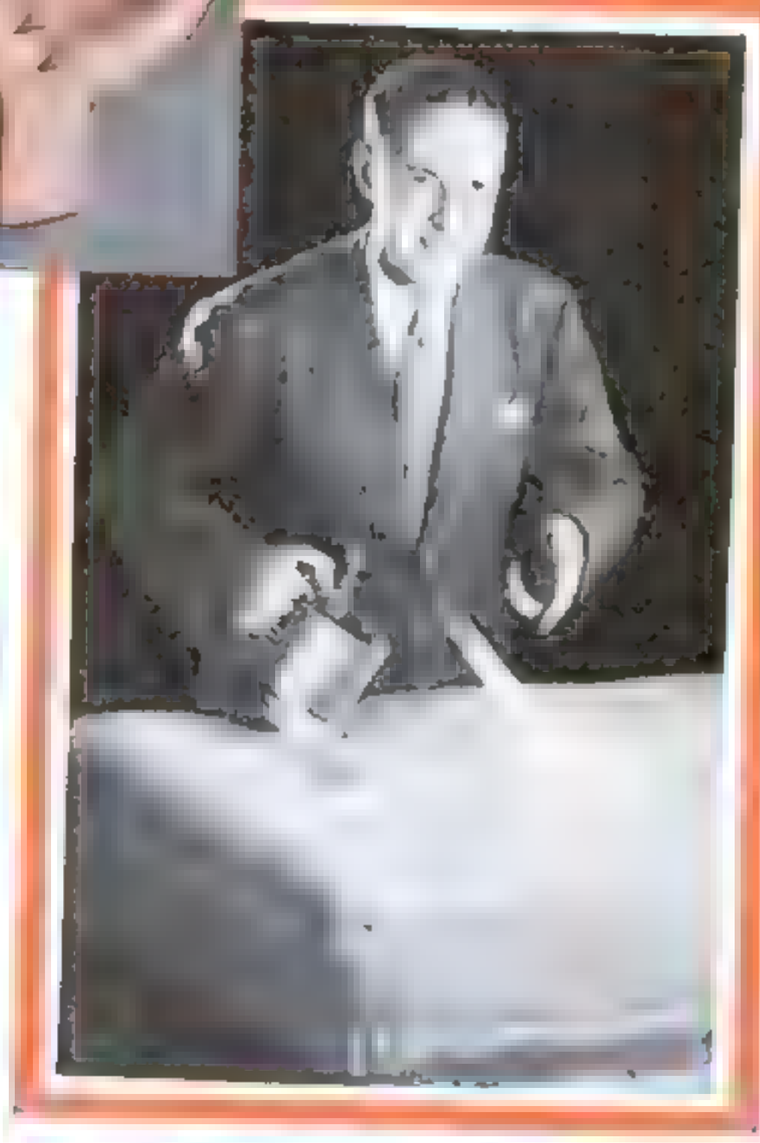
SCALE SPEEDS RECIPE MIXING. A rotating dial on this kitchen scale enables the housewife to weigh all the ingredients of a recipe in one bowl. As each item is added, the dial is set back to zero for the next. Graduations are in pounds and ounces

ENVELOPES FOR SANDWICHES. Individual bags of transparent wrapping material, for keeping sandwiches and cakes fresh, are now available. Accordion pleats at the sides make them fit snugly. Larger sizes fit fruits and other foods

ASH-TRAY CELLS SMOTHER BUTTS

When a lighted cigarette is stood on end in one of the cells of the novel ash tray shown at the right, it is put out at once. A patented cellular construction is employed

ELECTRIC FOOT WARMER. Immediate relief for cold feet is afforded by this electric foot warmer, which is covered with a porcelain shell It is said to yield a pleasant, uniform heat and to be very economical in current consumption



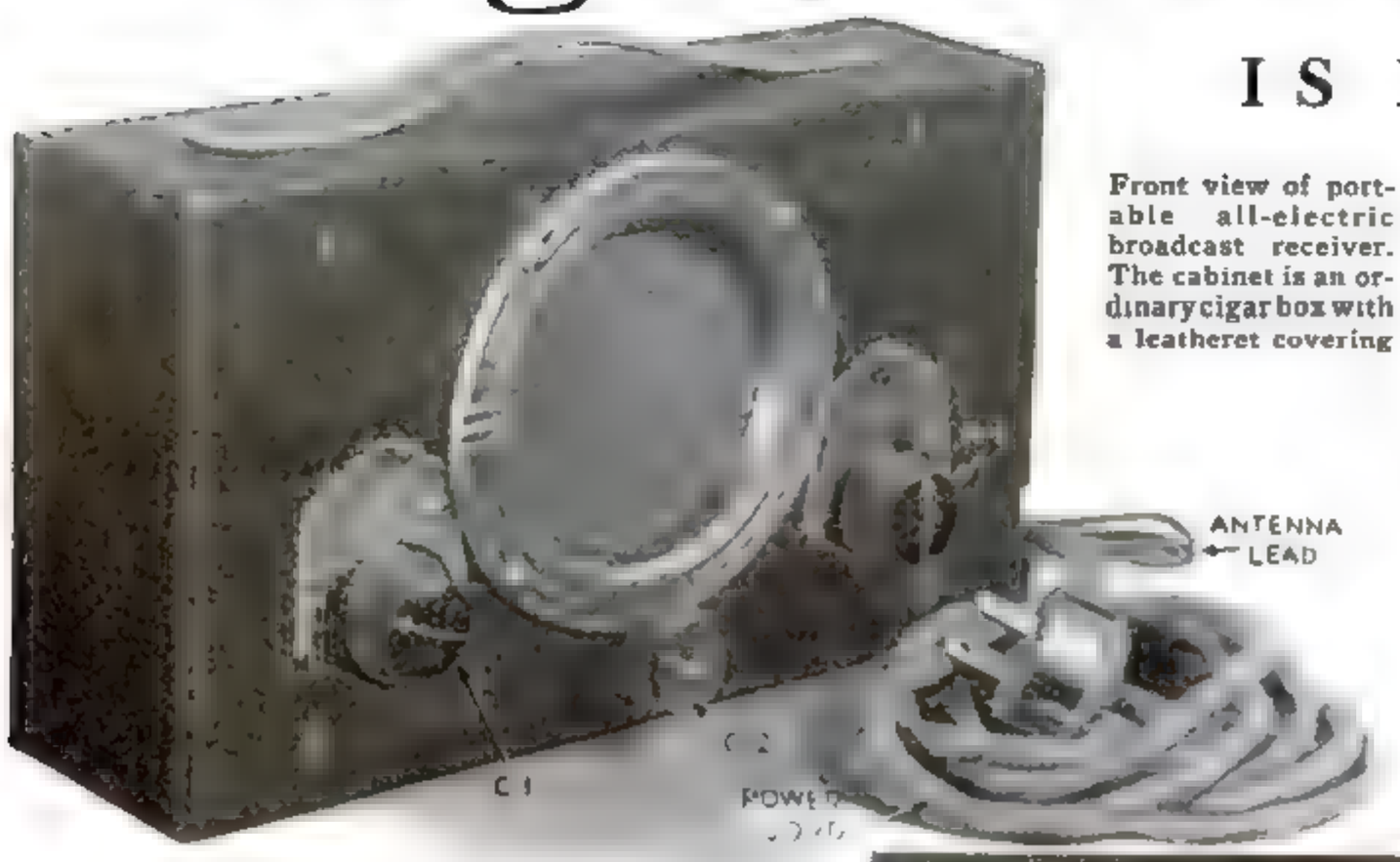
FIREPROOF MATTRESS. Smoking in bed is made a comparatively safe pastime by the introduction of a mattress in which all inflammable material has been chemically fireproofed. The photo shows it under test

MOTOR OPERATES WINDOW SHADE A reversible electric motor, operating on the house current, raises or lowers a window shade at the pressure of a button. The button is held down until shade is at desired level

SHAVING MUG HAS BUILT-IN SOAP DISPENSER. By turning a ring that forms a part of a new shaving mug, the user causes soap to be forced into the mug from a reservoir in the base. The mug is shown at right

Cigar-Box Portable

IS INEXPENSIVE



Front view of portable all-electric broadcast receiver. The cabinet is an ordinary cigar box with a leatheret covering

By WALTER J. BRONSON

A CIGAR BOX full of radio! That is what you will have when you complete the efficient little all-electric broadcast receiver illustrated. By careful planning and the use of midget parts and space-saving metal tubes, a complete three-tube circuit, loudspeaker and all, has been crammed into an ordinary cigar box.

In designing the circuit, the main thought was to provide the radio fan with an all-around personal receiver. A miniature broadcast set that could pinch hit for the big living-room receiver, an easily built outfit that could be stowed away in a traveling bag, and a simplified circuit that would give loudspeaker reception wherever a 110-volt power supply, either alternating or direct current, was available. The result is an inexpensive outfit that can be built by anyone who boasts a jack knife, a pair of pliers, a screw driver, a soldering iron, and a small drill.

A 2½ by 5 by 9-inch cigar box of the top-opening type will house the parts nicely. This eliminates entirely the cost of a cabinet. Covered with leatheret, it matches the appearance of the best in commercial cabinets.

To provide a rigid support for mounting the various parts, as well as a metal surface to serve as a common return lead, the hinged top of the cigar box, which serves as the front face of the cabinet, is lined with a 4¾ by 8½-inch piece of sheet aluminum. Also, to allow the front face to be opened easily, the top edge of the cigar-box cabinet is hinged by gluing a strip of heavy cloth along its rear edge.

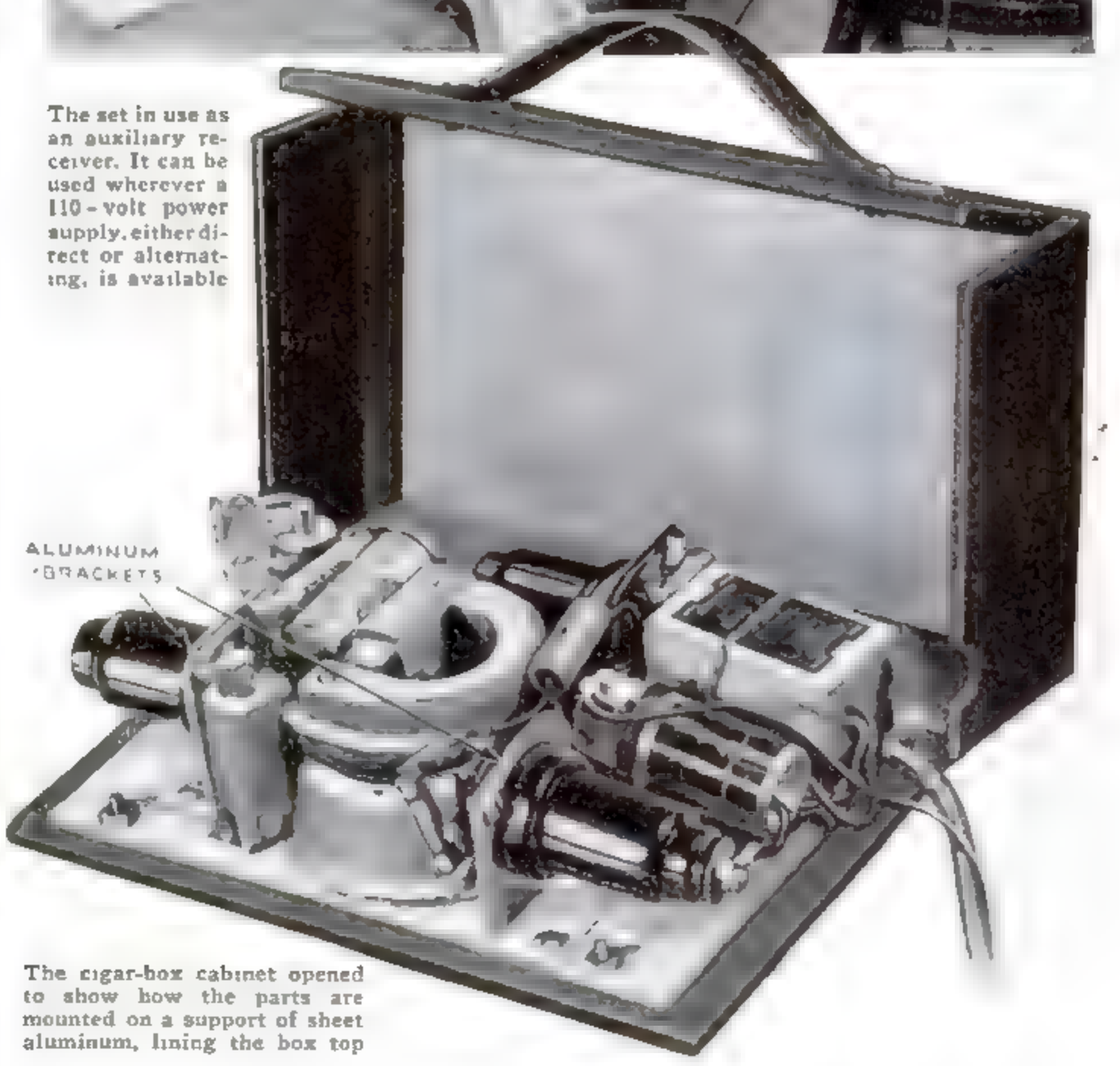
The three tubes employed are of the 6.3-volt, all-metal type. A single 6K7 serves as the combined radio-frequency and detector stages and a 6C5 used in a resistance-circuit provides audio amplification and drives the loudspeaker. For rectification, a second 6C5 is employed. These are mounted horizontally in conventional wafer sockets supported by L-shaped aluminum brackets.

For tuning, a single 140-mmf. variable condenser (C_1) is wired in parallel with a 100- to 500-mmf. *mica* variable condenser (C_2). This combination provides good selectivity and extended tuning range over the entire broadcast band. Both units are located on the face or panel of the cigar-box cabinet, the 140-mmf. condenser being placed at the extreme left while the 100- to 500-mmf. unit is located exactly in the center under the loudspeaker grille.

Coil difficulties are reduced to a minimum. An ordinary commercial high-gain A.C.-D.C. antenna coil is the only coil used. This type of coil, available at most radio-supply stores for a few cents, requires no socket. In the actual wiring of the receiver, three soldering lugs provide a convenient means of making the necessary connections.

Two electrolytic condensers comprise the

The set in use as an auxiliary receiver. It can be used wherever a 110-volt power supply, either direct or alternating, is available



The cigar-box cabinet opened to show how the parts are mounted on a support of sheet aluminum, lining the box top

Radio

TO BUILD

simplified filter circuit. One is a midget-type dual 8-mfd. condenser (C5) rated at 175 volts and the other, by-passing the cathode of the 6C5 audio tube, is a 12-mfd. unit (C6).

Care must be exercised in connecting the dual electrolytic condenser (C5) into the circuit. The positive lead of each unit must be connected exactly as shown in the diagram. This point should be kept in mind when purchasing the condenser. If a common lead is provided, it must be the negative terminal.

The tiny filter choke (Ch.) used in the original receiver was made by removing the small iron-cored coil from an old electric clock. The coil provides one of the smallest A.C.-D.C. iron-core filter chokes that can be obtained. If an old electric clock is not available, clock replacement coils can be purchased from many radio parts supply houses for a few cents.

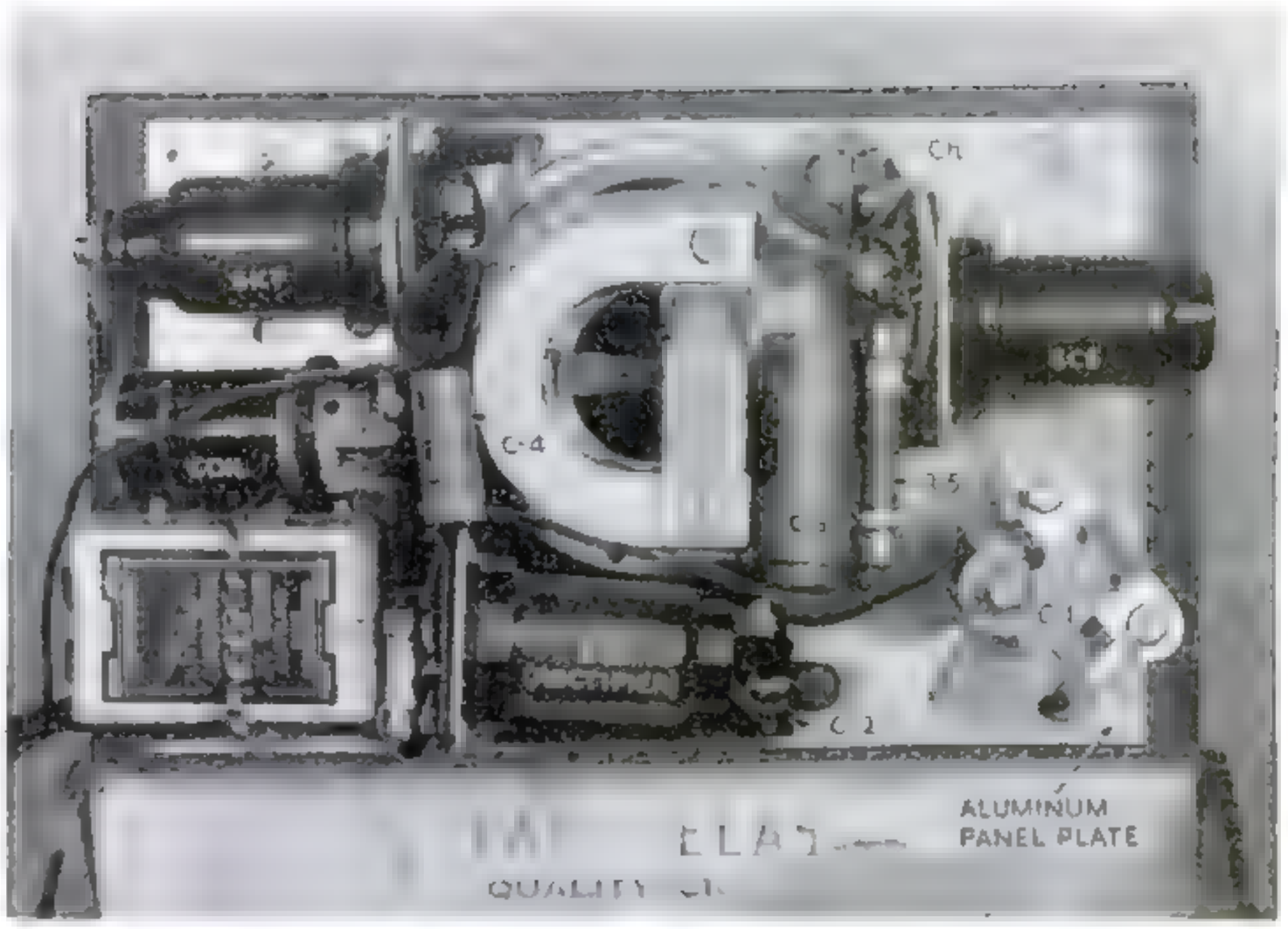
Volume is easily controlled by means of a 50,000-ohm potentiometer (R1) used to vary the screen-grid voltage to the detector tube. To save space, a combination volume-control-and-filament-switch should be used. This is mounted at the right of the speaker, in line with the tuning dial (C1), on the front face of the cabinet.

With but one exception, all resistors are of the half-watt, carbon type. The exception is a two-watt carbon unit (R5) connected into the cathode lead of the 6C5 audio tube. Although a one-watt resistor could be used in this position, the two-watt rating provides a margin of safety and prevents any possibility of a troublesome burn-out due to excessive plate current.

Filament supply for the three tubes is provided by a standard 360-ohm A.C.-D.C. line cord. This cord contains the dropping resistor which reduces the line voltage to the voltage required for the series-connected filaments. Since manufacturers' color codes on the three terminal wires used in these built-in resistance cords vary, examine the three wires and the plug terminal leads carefully before making the connections. The built-in resistance wire, generally identified by the fact that it is covered with asbestos, must be connected into the filament circuit. The remaining two wires provide the full line voltage of 110 volts for the rectifier and plate circuit.

Because of the limited space available, a midget three-inch-diameter magnetic speaker is used. If desired, a simple jack connection that will allow a pair of earphones to be substituted for the speaker can be made, or the speaker can be eliminated entirely and earphones wired permanently into the output of the audio tube.

For best results, the receiver should be used with a good antenna. In tests, a sixty-foot outside wire provided good room volume on more than a dozen broadcast stations. As in most A.C.-D.C. circuits, no ground is used.



Another view of the receiver. Because of space limitations, a midget three-inch magnetic speaker is used. The three tubes are mounted horizontally on L-shaped aluminum brackets

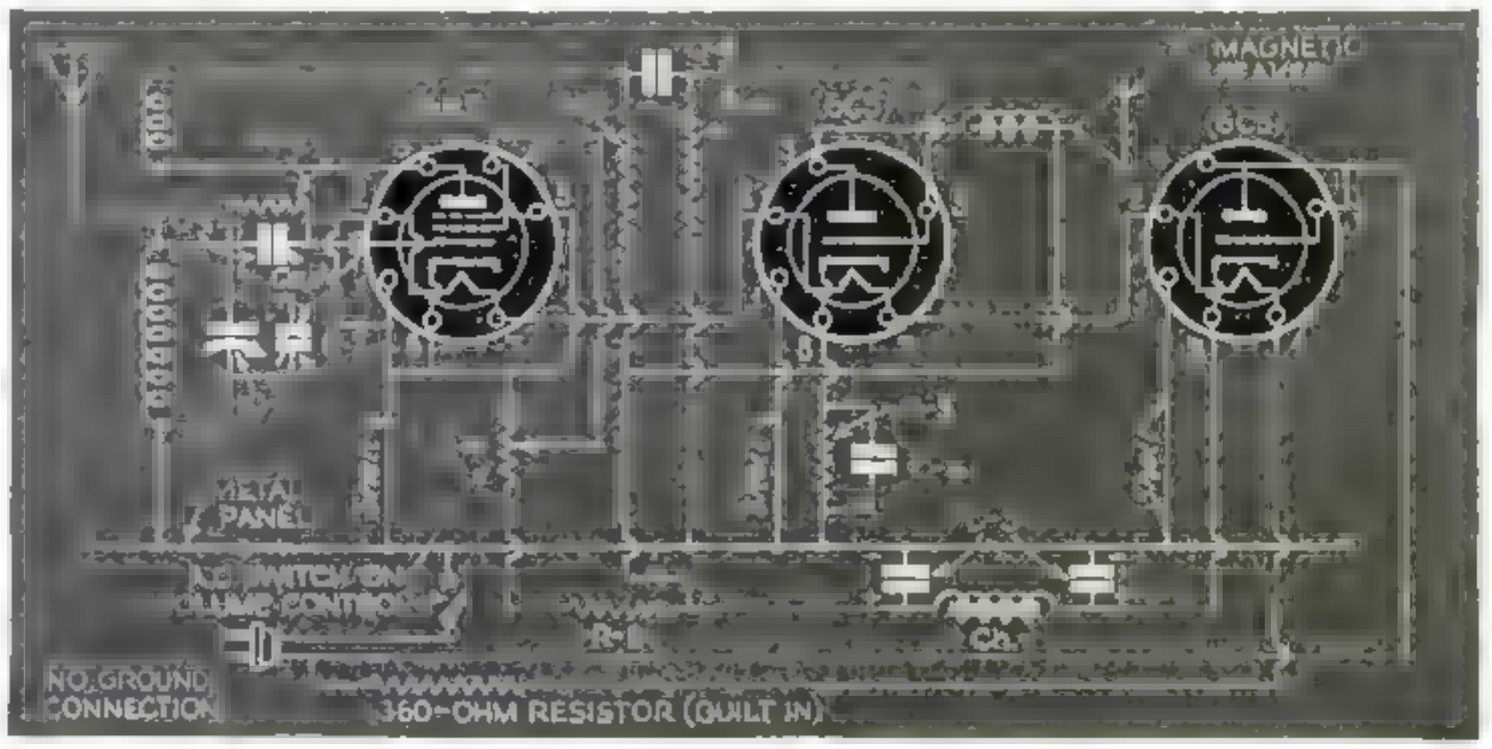


Diagram of simplified circuit. The various units are numbered for comparison with the list of parts needed for building the set

LIST OF PARTS

C1.—Variable condenser, midget, 140 mmf.
C2.—Variable mica condenser, 100 to 500 mmf.
C3.—Fixed condenser, .0001 mfd.
C4.—Fixed condenser, .01 mfd.
C5.—Dual electrolytic, 8-8 mfd., 175 volt.
C6.—Electrolytic condenser, 12 mfd., 25 volt
R1.—Volume control, potentiometer, 50,000 ohm.
R2.—Fixed resistor, 1 meg
R3.—Fixed resistor, 150,000 ohm, ½ watt.
R4.—Fixed resistor, 250,000 ohm, ½ watt.
R5.—Fixed resistor, 4,000 ohm, 2 watt.
R6.—Fixed resistor, 100,000 ohm, ½ watt.
ch.—Filter choke (see text).

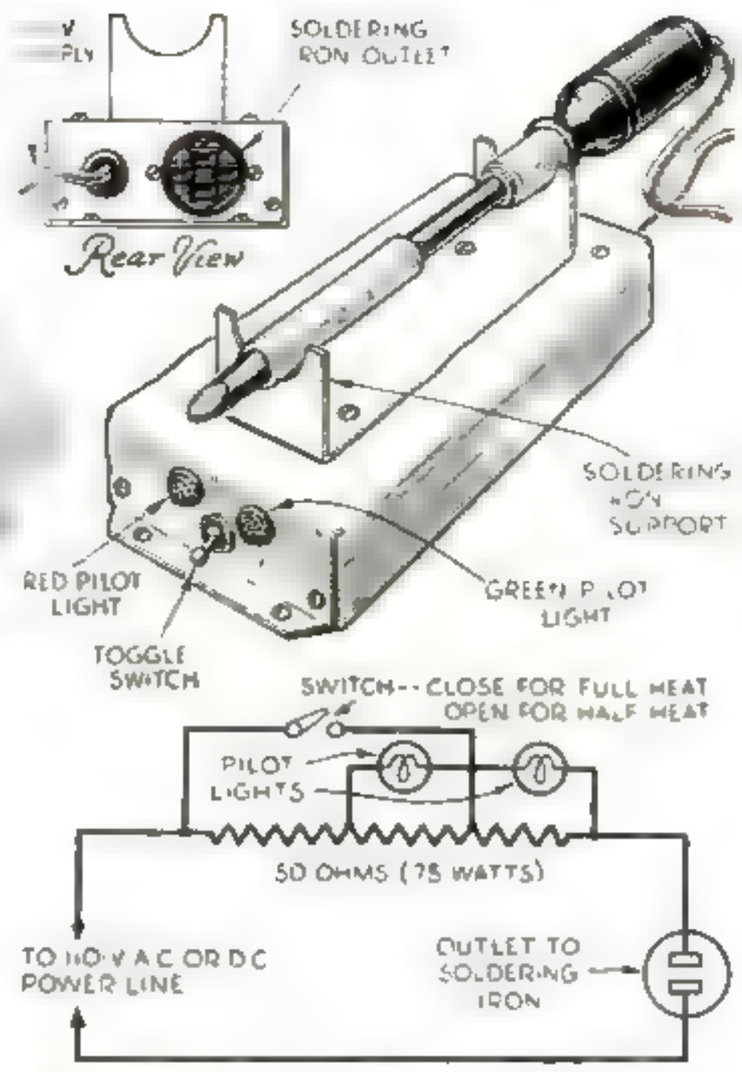
Miscellaneous: Cigar box, sheet aluminum, three-inch magnetic speaker, wafer sockets, metal tubes, 360-ohm line cord, leatheret dial plates, knobs, speaker grille and plate, wire, nuts, solder, etc.

The receiver being stowed in a suit case for traveling. Because of its compactness and adaptability, it is ideal for this purpose

Handy Radio Aids

FOR SET BUILDERS

BY MAKING it possible to reduce the voltage supplied to an electric soldering iron when it is momentarily not in use, the homemade rest illustrated not only prolongs the life of the iron but makes frequent retinning unnecessary. The circuit, assembled in an aluminum chassis, which also serves as the support, consists simply of a power resistor provided with movable taps, two 2.5-volt pilot lights, a red-jewel window, a green-jewel window, and a toggle switch. Closed, the switch provides the full 110 volts to the iron. Opened, it reduces the voltage and the heat. At full heat, the red pilot lamp is lighted, while the green



pilot glows at low heat. The resistance across each pilot light should be adjusted to the point that allows the lamp to light when the switch is in the proper position.

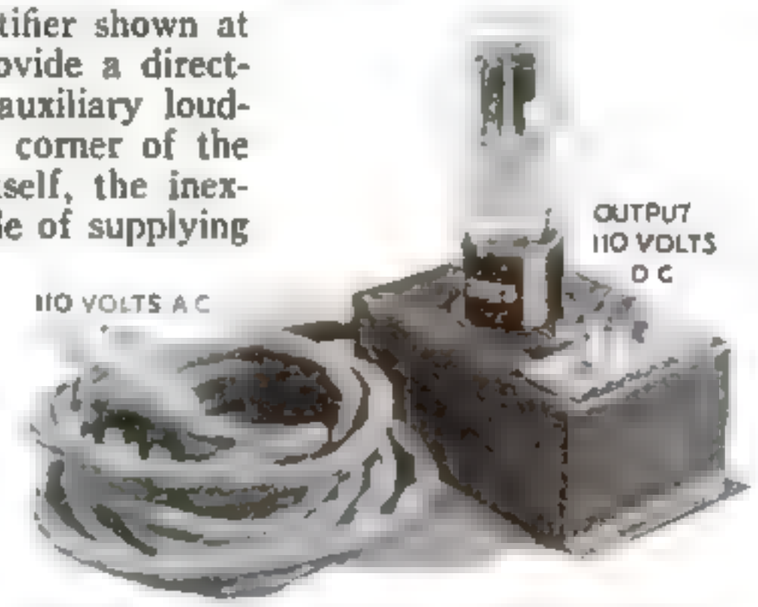
RadioTool Carries Own Light

WORKING in the dark depths of a radio circuit is made easy by a new illuminated screw driver. A standard flash-light cell housed in its hollow-metal handle powers a small bulb mounted in a transparent tip that holds the blade. Turning the screw-top of the handle lights the bulb and illuminates the business end of the screw driver in a circle of light. For convenience, the handle is supplied with a pocket clip.

This illuminated screw driver is handy for working in dark corners

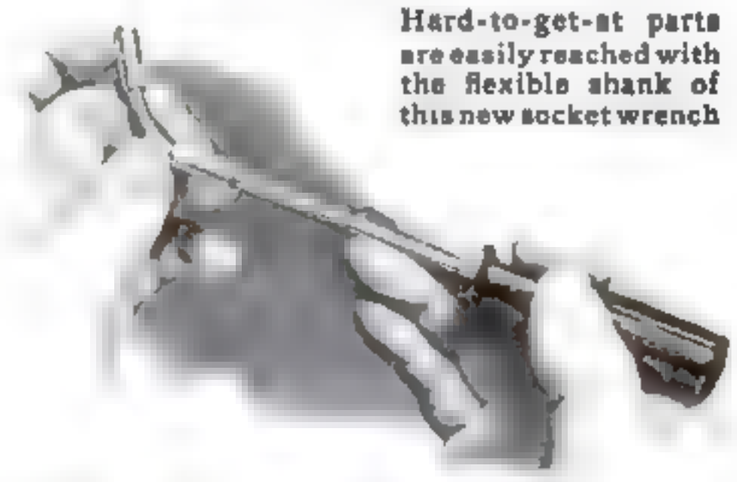
Small Rectifier Powers Auxiliary Speaker

WITH the compact and inexpensive rectifier shown at the right, it is a simple matter to provide a direct-current power supply for the field of an auxiliary loudspeaker. Small enough to be mounted in a corner of the small speaker cabinet or on the speaker itself, the inexpensive unit, rated at twelve watts, is capable of supplying 100 volts of direct current at 120 milliamperes when plugged into a 110-volt, alternating-current house line. The circuit, housed in a neat crackle-finish metal chassis, makes use of a 25Z5 rectifier tube. Four holes drilled in narrow flanges at the ends of the chassis provide a means for mounting the unit with either screws or bolts. Connections to the speaker field are made through two convenient terminals.



Compact rectifier unit for auxiliary speakers

New Socket Wrench Has Flexible Shank



Hard-to-get-at parts are easily reached with the flexible shank of this new socket wrench

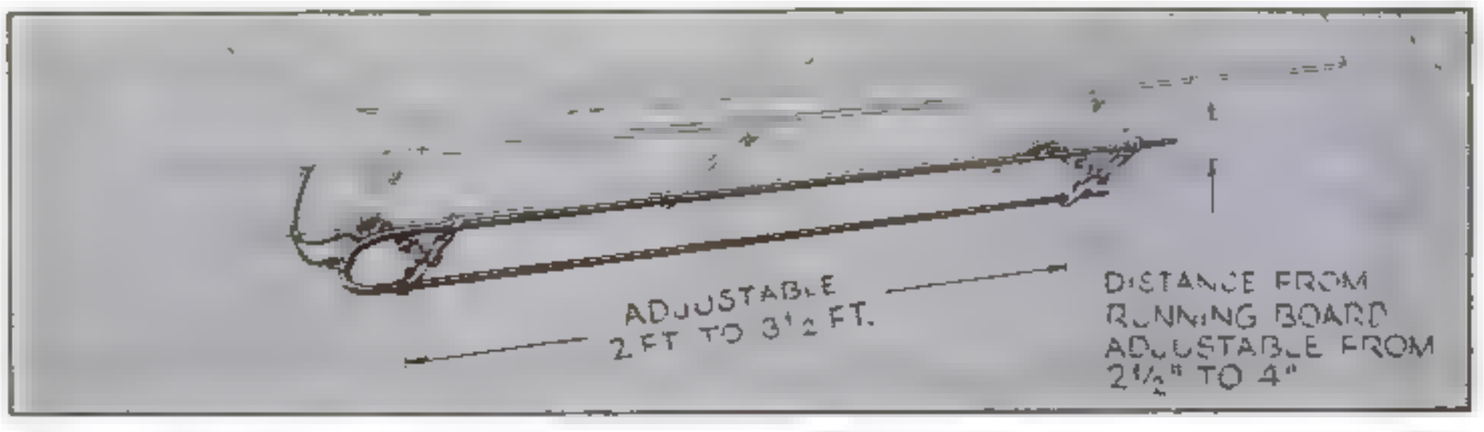
HAVING a flexible shank, a socket wrench recently placed on the market eliminates the problem of adjusting nuts and bolts located in the hard-to-get-at corners of a crowded radio cabinet. Although designed primarily for receiver-aligning work, its socket will fit a large variety of nuts encountered by the radio builder in his everyday jobs.

Interlocking Fuse Case For Auto Receivers

FOR use in auto radio receivers, a recently developed fuse holder can be connected into any supply lead. Designed for standard automobile fuses, the two-piece case has a spring bayonet lock that insures good contact at all times. When it is necessary to replace a fuse, a twist opens the interlocking case.

Di-Pole Antenna Serves Steel-Top Autos

DESIGNED especially for use on modern steel-top automobiles, a new di-pole antenna is easily installed under the running board. Mounted on the running-board bolts, the U-shaped unit in reality serves as a counterpoise while the car itself acts as the antenna. Any noise from near-by man-made static sources, such as the ignition system, is eliminated by the cancellation effect of the di-pole construction. Hinged mounting brackets allow the unit to be adjusted to insure road clearance. The antenna may also be adjusted in length from two to three and a half feet.



Adjustable di-pole antenna mounted under the running board of a car. It serves as a counterpoise

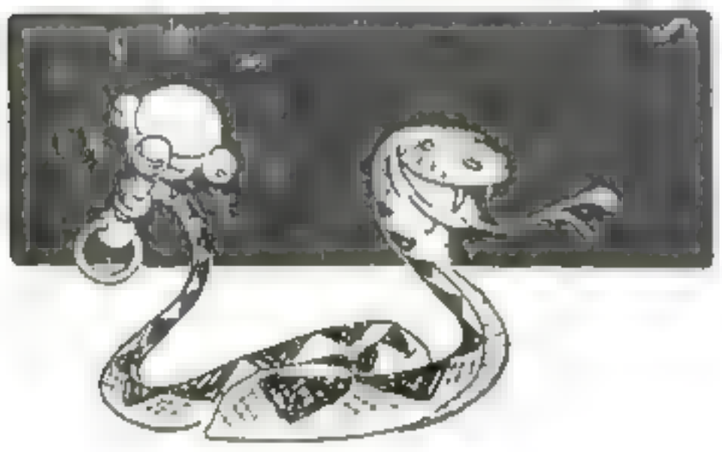
Question: How did the pineapple come to be called by that name?—P. K., Macon, Ga.

Here's *the* Answer

A.—THE pineapple received its name from the Spaniards who first explored the tropical areas of the Americas. They likened its appearance to a pine cone and suffixed apple, probably to denote that the newly found fruit was edible.

Plenty of Ice Left

G. C. S., PORTLAND, ORE. About 6,000,000 square miles of the earth's surface are still covered with ice and 5,000,000 of them are in the Antarctic.



Don't Wait for the Rattle

P. S. C., HARRISBURG, PA. Rattlesnakes do not always "rattle" before striking. In tests, only about one half of the snakes "rattled" when a would-be captor came within striking distance.

When Sharks Flatten Out

Q.—SHARKS, when hauled out of the water onto the beach or the deck of a boat, flatten out. What causes this?—T. B. C., Jacksonville, Fla.

A.—SHARKS do not have a bony skeleton, but one composed mainly of cartilage. This elastic structure sags under the weight of the shark's body when it is placed on an unyielding surface, such as the deck of a boat.

When Oil Shows Its Colors

Q.—WHAT causes a film of oil on water to be iridescent?—T. A., Rockford, Ill.

A.—WHEN rays of light strike a film of oil, or any other transparent substance, the rays are reflected back to your eyes from both the upper and under surfaces of the film. In these two series of light waves, some of the waves will interfere with each other, that is, the crest of one wave will coincide with the trough of another. Wherever this happens, they will be neutralized and the colors which normally would be formed will be missing. When rays of any given wave length are removed from a beam that produces a white light, the remaining rays take on a color that is complementary to the missing rays. With this happening a great many times in the light rays coming from the film of oil, the film becomes iridescent. Those light waves which are in phase (crest to crest or trough to trough) augment each other and produce a color which is twice as bright as either of the single waves could set up.

So Cold It Creaks

T. M. M., DULUTH, MINN. Snow creaks under your feet in extremely cold weather because the low temperature keeps the snow from melting under this pressure and the dry snow crystals, being compressed, slip over one and another causing the characteristic creaking sound.

Tips on the Moon

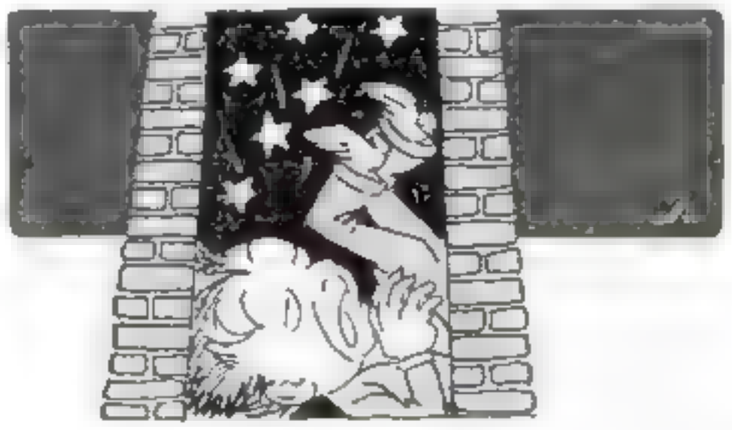
Q.—DO THE tips of the crescent moon ever point towards the horizon?—L. S. B., Canton, Ohio.

A.—THE horns of the moon always point away from the horizon and never towards it. This is so because they must always point away from the sun, which is below the horizon at night. Artists sometimes erringly paint the moon with the horns pointing the wrong way.

Before the Stove Era

Q.—WHY did people of ancient civilizations make their cooking pottery with rounded instead of flat bottoms?—W. C., Wichita, Kans.

A.—PREHISTORIC cooking vessels had rounded bottoms, it is suggested by archaeologists, because such bases nested more firmly on the stones or supports of the fireplaces used for cooking.



Yes, If You Fall Down the Well

Q.—CAN stars be observed in the daytime from the bottom of a deep well or tall chimney?—A. W. D., Colorado Springs, Colo.

A.—A VERY bright star might be seen, but certainly no others. Star gazing from the bottom of a deep, dry well or lofty chimney is doubtful, at best.

Peering Through the Haze

Q.—WHY is it that a haze makes the setting sun appear reddish in color but gives distant mountains a bluish appearance?—A. M. G., Elmira, N. Y.

A.—HAZE is made up of a mass of tiny nuclei, such as particles of dust and soot and molecules of gas to which water vapor clings. These minute particles of haze scatter the short waves of blue light more than the longer red waves. The result is that the haze looks blue and when it is interposed between the observer and a light such as the sun, it changes the color of the light to a reddish hue. It is like looking at the sun through blue glasses. In the case of a distant mountain, what the observer is seeing is not the mountain but the blue haze intervening between himself and the mountain. The mountain serves to outline and contrast the haze with the surrounding atmosphere.

Without St. Patrick's Aid

Q.—WHAT is the scientific explanation for the absence of snakes in Ireland?—P. A. M., Malden, Mass.

A.—ANY snakes that might have been in Ireland were destroyed or driven from the land by the ice of the Pleistocene age. During this period a sufficiently large part of Ireland was covered with ice so as to make any part of the land uninhabitable for reptiles. When the ice receded, Ireland was separated from the nearest land, England, by a body of salt water. No reptiles could migrate across this sea since the only known snakes to inhabit salt water are in the tropical regions.

Twisted Into Beauty

A. W. P., QUINCY, MASS. The beautiful grain of the Circassian walnut tree is caused by the rigorous climate of the Caucasus to which area, as its name implies, the tree is native. The wood fibers of the young trees are twisted and gnarled by strong winds and, as the tree develops, they form the beautiful patterns seen in cross section.

A Difference in Sea Level

L. S. S., BAYONNE, N. J. Sea level is not the same at all locations. In this country and Canada, for instance, it is higher on the Pacific than on the Atlantic coast. Mean sea level at Prince Rupert, B. C., is 1.64 feet higher than at Halifax, N. S.; at Seattle, 1.18 feet higher than at Portland, Maine; at San Diego, Calif., 1.74 feet higher than at Fernandina, Fla.

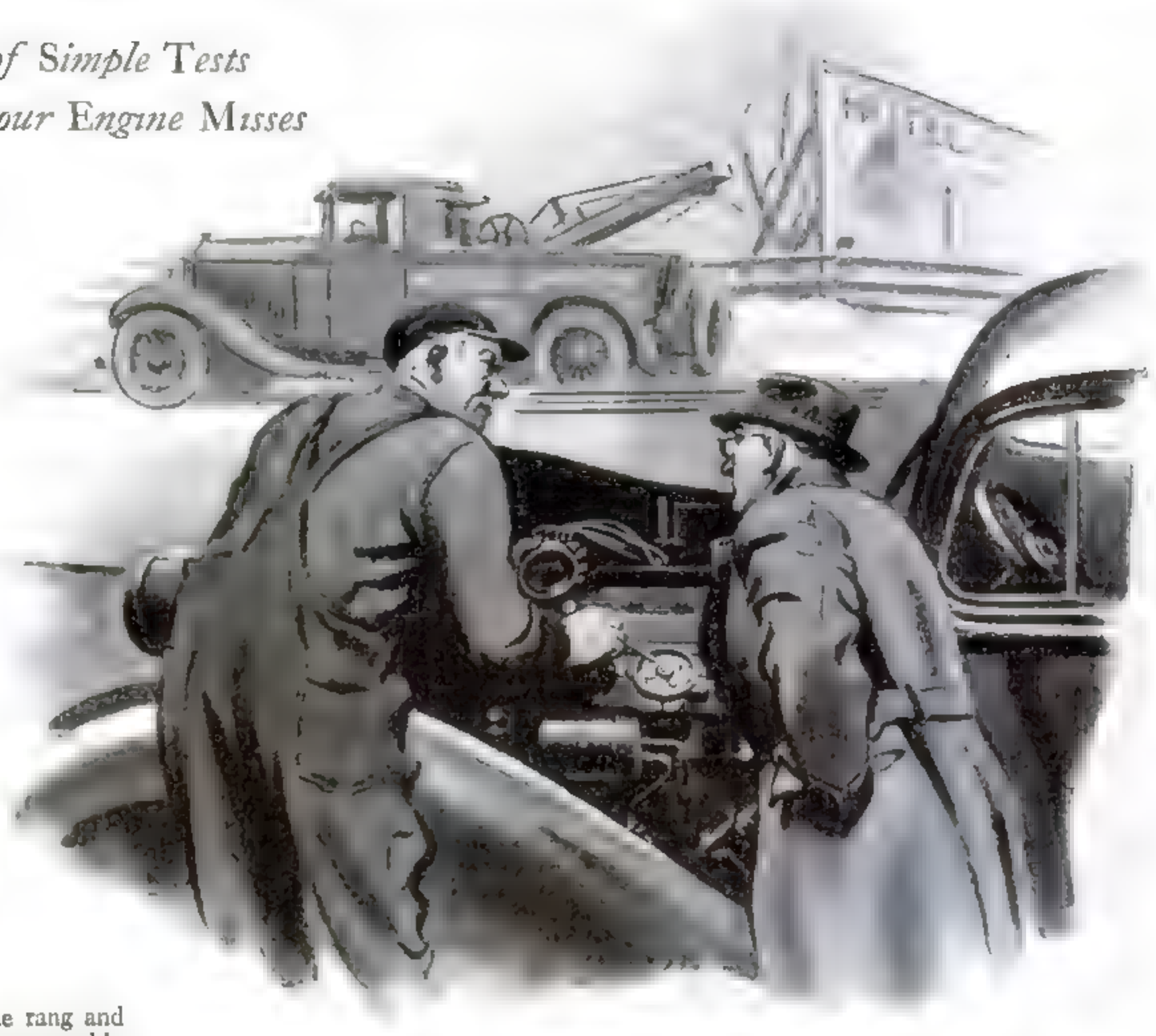
That Masculine Profundo

Q.—WHY is it that a man's voice is so much deeper than a woman's?—C. R. C., Sydney, Australia.

A.—A MAN'S vocal cords are larger and heavier than those of a woman and it is this difference in construction which causes a man's voice to be of a lower pitch. This difference in sound is the *(Continued on page 129)*

Spotting Ignition Trouble

Gus Gives a List of Simple Tests To Make When Your Engine Misses



As Gus opened the distributor and bent over to inspect it, his face broke into a grin. "There you are!" he exclaimed. "The timer contact lock has worked loose, and the gap has closed up."

"I'LL BET there's at least a bucketful of carbon in this motor, Gus," said Mason Backett, as he pulled in at the Model Garage and Gus Wilson, half owner and mechanic of the establishment, came out to see what he wanted.

"Sounds as if it had a lot—maybe a couple of cupfuls," the veteran auto man grunted, after testing the motor for a minute, "and that's a plenty without filling any buckets!"

"How soon can you get a valve-and-carbon job done?" Backett asked.

Gus scratched his head. "Come back about three o'clock this afternoon. I'll have it done by then."

At the appointed time, Backett returned, got in his car, and drove off. About an hour later, the phone rang and Joe Clark, Gus's partner in the ownership of the Model Garage, came to the door of his office. "Backett on the phone," he called. "Says he's stuck about ten miles up the road near Parrville. He sounds sore as a boil. Claims you busted most of his spark plugs when you cleaned them on that carbon-and-valve job. Better go fix him up. I'll look after things here."

Backett, his hands covered with grime and a streak of black smeared across his face, was still working over the spark plugs when Gus drove up. At the rumble of the service car, he pulled his head out from under the hood.

"Heck of a job you did on this car!" he growled, angrily. "What did you clean these plugs with, anyhow—a sledge hammer? All but two are shorted and I can't get anywhere on two cylinders. She started missing on one cylinder before I'd come two miles from your place. I found the bum plug by shorting them out one at a time with a screw driver, and replaced it with an old spare I found in the tool kit. But that must have been on the blink, too, because it kept right on missing, and then the other plugs went dead in the next few miles. It's up to you to replace all the plugs you've busted and darned if I don't think you ought to pay me for the time I've wasted!"

"Say, mister," snapped Gus, "if a single spark plug goes bad that's commonplace. If two go dead at once, that's as rare as pinfeathers on a turtle. If three or more went dead at the same time, that would

By MARTIN BUNN

be nothing short of a miracle! You're barking up the wrong tree. It just couldn't be spark plugs."

"Not spark plugs!" snarled Backett. "What else *could* it be? Didn't I hold the screw driver against each one and get absolutely no sign of a spark?"

"Maybe you did," Gus retorted, "but I'll bet a hat you didn't disconnect one of the spark-plug wires and hold it near the plug to see if there was any current flowing to the plug. Start up the motor, and we'll try that."

Backett got the crippled motor going, and Gus, after picking out an apparently dead plug with the aid of the screw driver, snapped the cable loose and held it close to the plug terminal. There was no sign of a spark. He reached around and shut off the motor.

"Trouble with you," he grumbled as he replaced the plug wire, "is that you're like too many other fellows—always jumping at conclusions. First off, when the motor started missing, trying the plugs with a screw driver was the right thing to do and when you got no spark at one of 'em, replacing it was O.K. I'd have done that myself. And when it kept on missing on that same cylinder I'd have concluded as you did that the old plug from the tool kit was sour, too. But by the time the other cylinders began to cut out you had it so firmly fixed in your noodle that it must be spark plugs you never even thought of looking for anything else."

"All right, I'll bite. What is it?" Backett growled, as he unconsciously added another streak to his facial decoration.

"Dollars to doughnuts it's right here," said Gus, opening the distributor and bending over to inspect it. His face broke into a grin. "There you are! Timer contact lock has worked loose, and the gap has closed up."

"But that would stop the motor entirely," Backett protested.

"It would, but for the fact that nothing made by human hands is absolutely perfect. No matter how nearly true the timer cam may be, by the time it's mounted on the shaft it is sure to run out of true a tiny bit, so that some of the humps on the cam lift the contact arm just a shade more than the others. When the gap was slowly closed by the loose contact turning in its thread, first the lowest hump on the cam couldn't quite make the grade, and that cylinder got no more spark. Then, as the vibration closed it still farther, more cylinders cut out until only the two served by the two highest humps on the *(Continued on page 120)*

Flying Ball...

AN EXCITING NEW MARBLE GAME ANY ONE CAN MAKE

By Charles Vanuck

When the plunger is released, the ball strikes the hurdle and flies upward toward the holes

Rear of the panel showing how the holes are laid out so clear passages may be run from each one. At right is the firing mechanism

The completed base unit, shown at the left, has seven scoring pockets into which the balls return

PLENTY of excitement and fun is in store for any one who makes this game. It will amuse the entire family for hours. The balls leap and fly into the targets or pockets with such speed that it is often impossible to see exactly where they have gone until they drop out of the holes at the bottom and into the scoring pockets.

The box and cover are each about 10 by 12 in. and 1½ in. deep. The bottom and the outside covering of the top can be made from heavy cardboard. The inside panel of the top should be made from light plywood, pressed composition wood, or ¼-in. pine. The holes that serve as pockets for the balls as they are shot are bored or cut 1¼ in. in diameter.

By referring to the photograph that shows the layout from the back, you will see that the holes must be carefully located so that the channels can be placed without interference. These channels are made from ¼-in. wood and should be at least ⅛ in. wider than the diameter of the balls used.

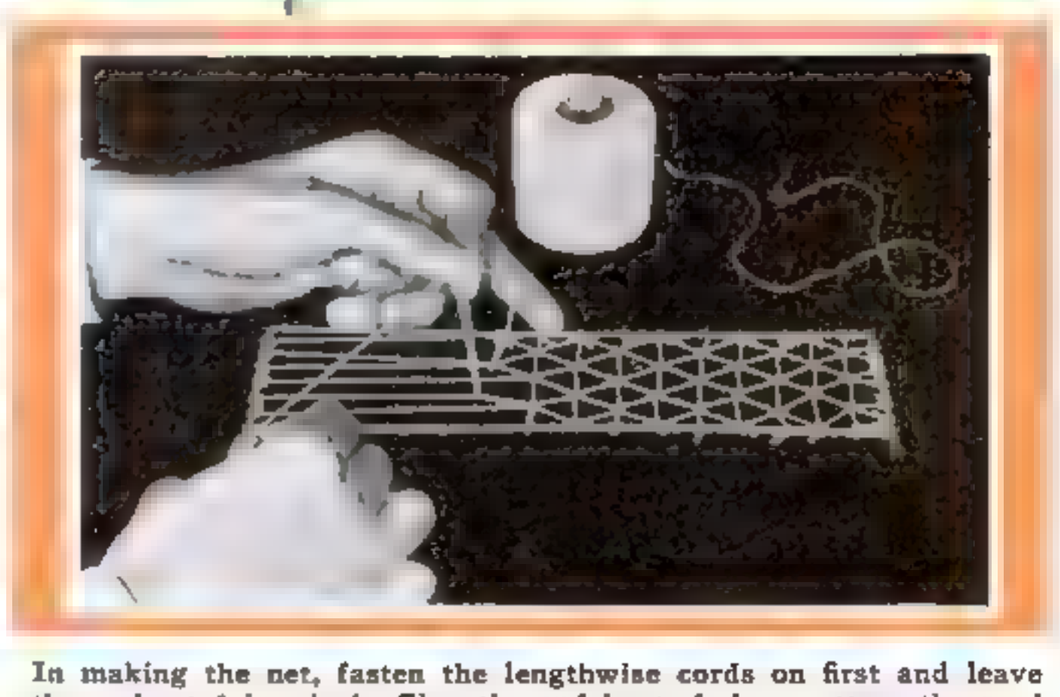
In the model shown, ½-in. agate marbles were used for balls, and the channels were made ¾ in. wide. Place a small wedge-shaped bit of wood at the bottom of each channel so that when the balls fall down the channel they will land on the wedge and be ejected into the scoring pockets. The holes at the bottom of the panel should be just large enough to pass the balls freely. The scoring pockets are spaced so as to correspond with these openings.

Place scoring numbers in the pockets. An old calendar will furnish the numbers. The highest pockets are the easiest ones in which to place the balls, so they should be given the lower scoring numbers. The highest number should be placed on the lowest central hole. The balls travel the shortest distance when shot at this hole, and it requires some judgment to shoot them with just enough force to score here.

The firing mechanism is constructed from three pieces of wood and a piece of wire coat hanger or other heavy wire for the plunger. The spring for the model was made from half of a spring from an old electric flatiron cord, but a suitable spring can be purchased from your hardware dealer for a few cents.

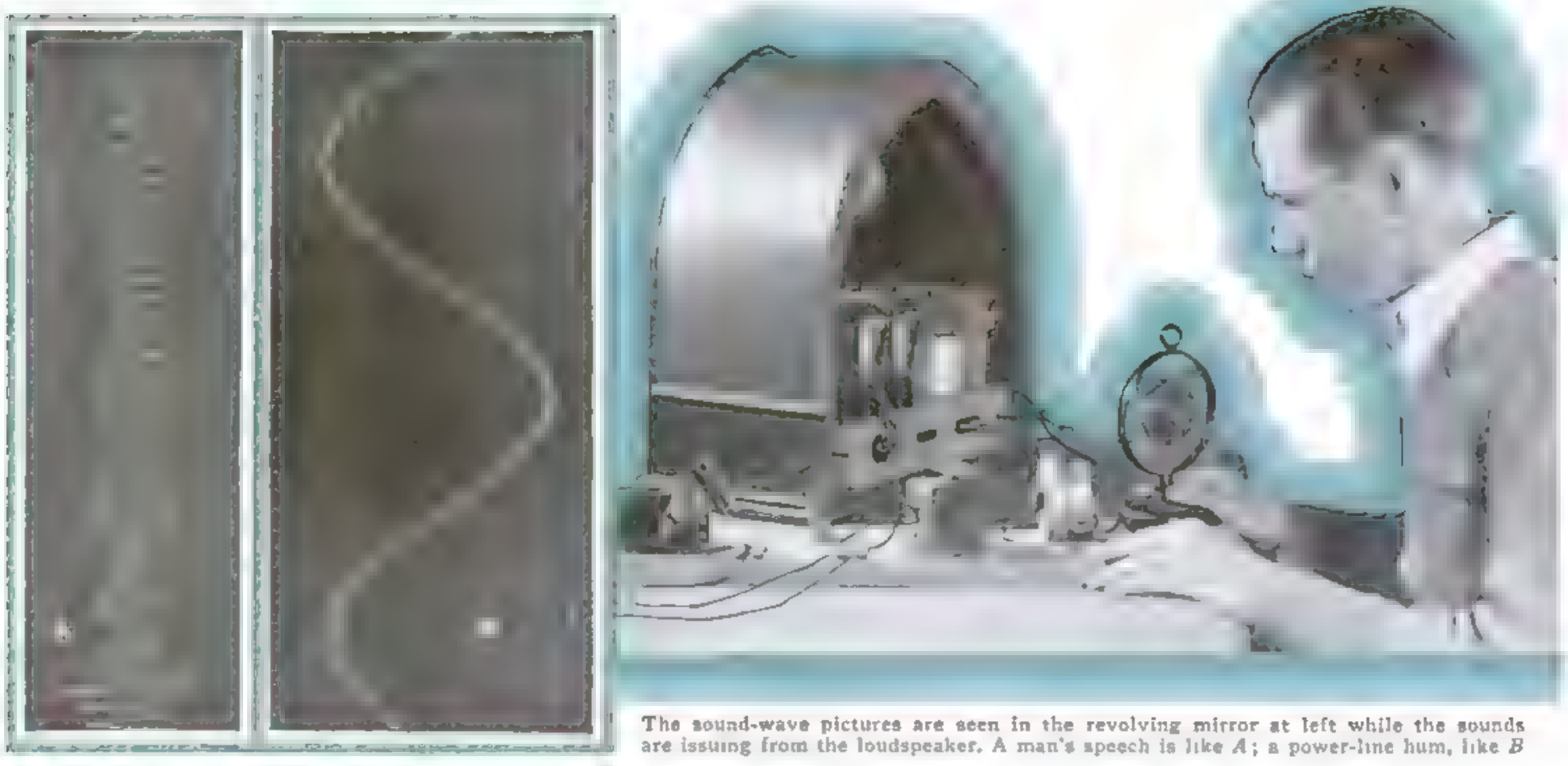
Form a tight loop at one end of the plunger and bend the loop at right angles to the wire to form a surface to strike the balls. The other end of the plunger passes through a ¼-in. hole in the side of the box nearest the player, therefore the ring for a finger grip should not be formed until the firing mechanism has been assembled in place.

The "gun" is located centrally in the bottom of the box and is fastened to the bottom with *(Continued on page 99)*

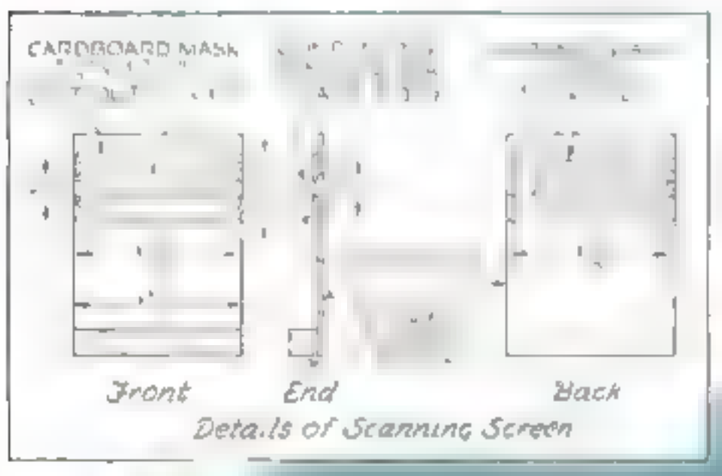


In making the net, fasten the lengthwise cords on first and leave them about 1 in. slack. Glue the end knots before cutting the cord

UNIQUE HOMEMADE Oscilloscope Shows



The sound-wave pictures are seen in the revolving mirror at left while the sounds are issuing from the loudspeaker. A man's speech is like *A*; a power-line hum, like *B*



ALTHOUGH you can build it at trifling cost, this remarkable instrument makes sound visible. It produces a fascinating motion picture of sound waves occurring as rapidly as 2,000 or more a second, and forms a graphic image of your voice, favorite radio program, or even the hum of an alternating-current power line. Those who do their own photographic developing can also record the image of the waves permanently on ordinary roll film.

The secret of the device is explained by the old bromide, "It's done with mirrors." The technical name for it, in fact, is a vibrating-mirror oscilloscope. Forbidding as this may sound, the principle of operation is really quite simple

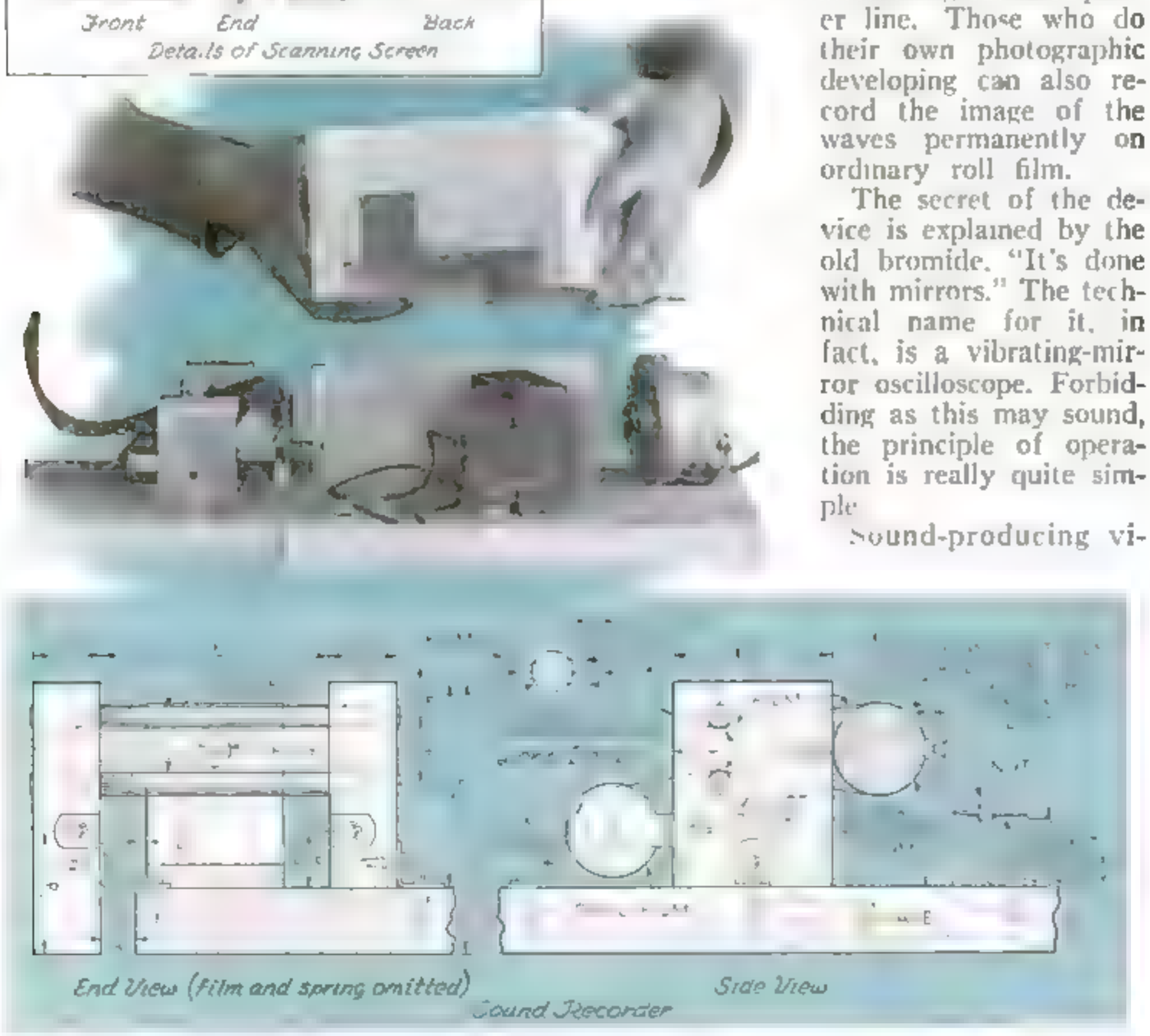
Sound-producing vibrations are impressed on a beam of light, which moves in accordance with these vibrations. This is accomplished by means of two mirrors. One is vibrated by sound waves and gives the light beam its horizontal scanning motion and the wave image its width or amplitude. The other mirror revolves and spreads out the image in a vertical direction.

If the vibrating-mirror speaker unit is connected with the radio in exactly the same way as an ordinary magnetic loud speaker (P.S.M., Feb., '34, p. 54), the sound waves will cause the mirror to vibrate. This makes a point of light on the ground glass of the scanning screen expand horizontally into a line. When viewed in the revolving mirror, this line appears in the form of sound waves such as are illustrated. Thus the sound waves are visible at the same instant they issue from the radio loud speaker.

A "home broadcast" microphone connected to the radio (P.S.M., Apr. '33, p. 62) enables you to see your own voice or any other local sounds. If the unit is connected directly to a toy train transformer at about 14 volts, the a.-c. hum of the house current is easily seen.

In constructing the oscilloscope, the first step after cutting the base to size is to assemble the vibrating mirror unit. This consists of an old magnetic speaker unit of the so-called "Baldwin" type, obtainable for considerably less than a dollar from most radio supply mail-order houses. Over the end of this is stretched a piece of thin rubber from a toy balloon, which is held in place with a rubber band.

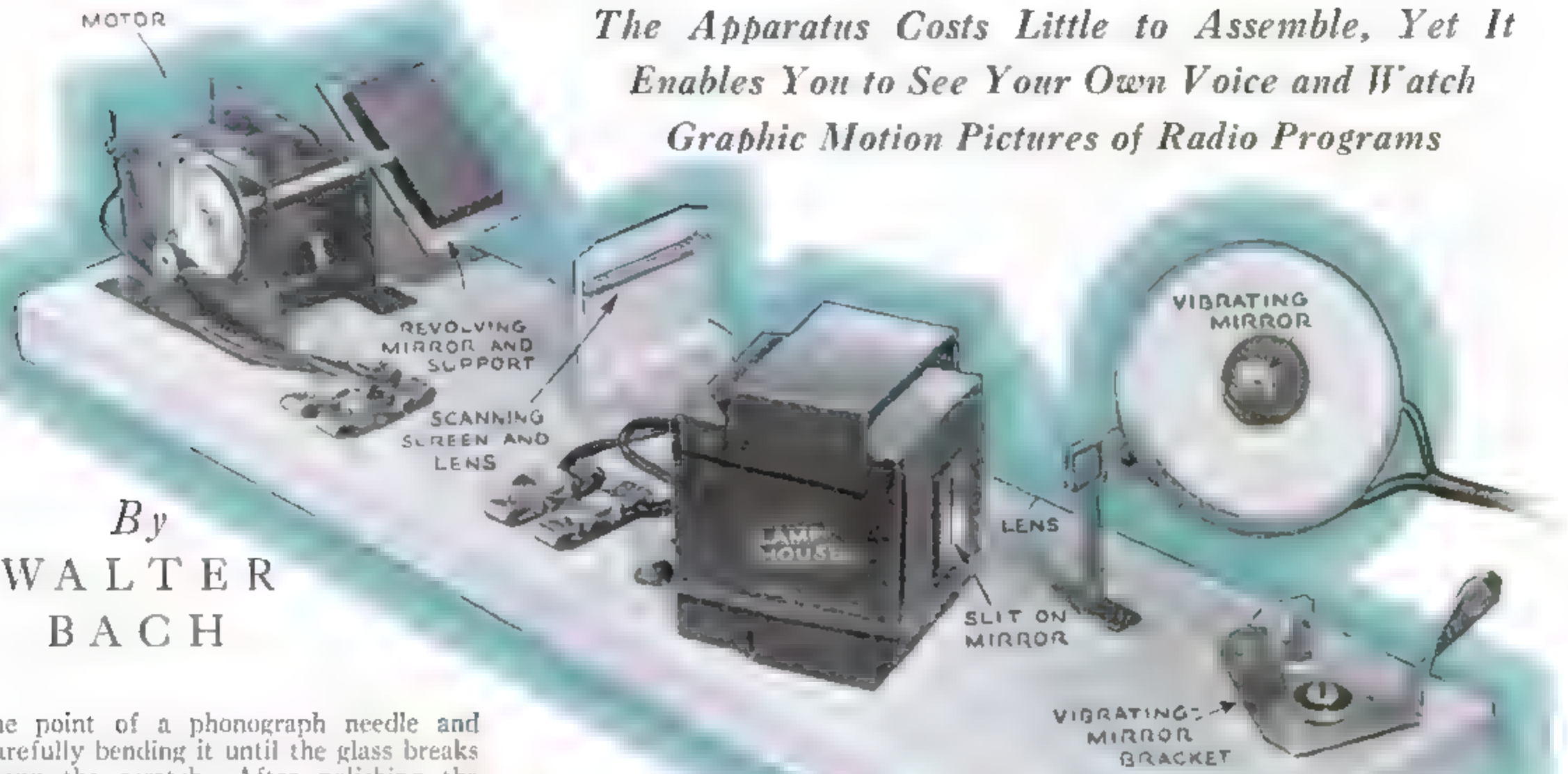
A ¼ by ¼-in. mirror, made from a microscope cover glass, is fastened to one side of the rubber with cellulose or "household" cement. The cover glass is cut by scratching it lightly with the jagged edge of a broken razor blade or



Details of scanning screen and sound recorder, and photograph of shoe box to shield recorder against stray light. A cardboard strip helps shield the condensing lens from the lamp house

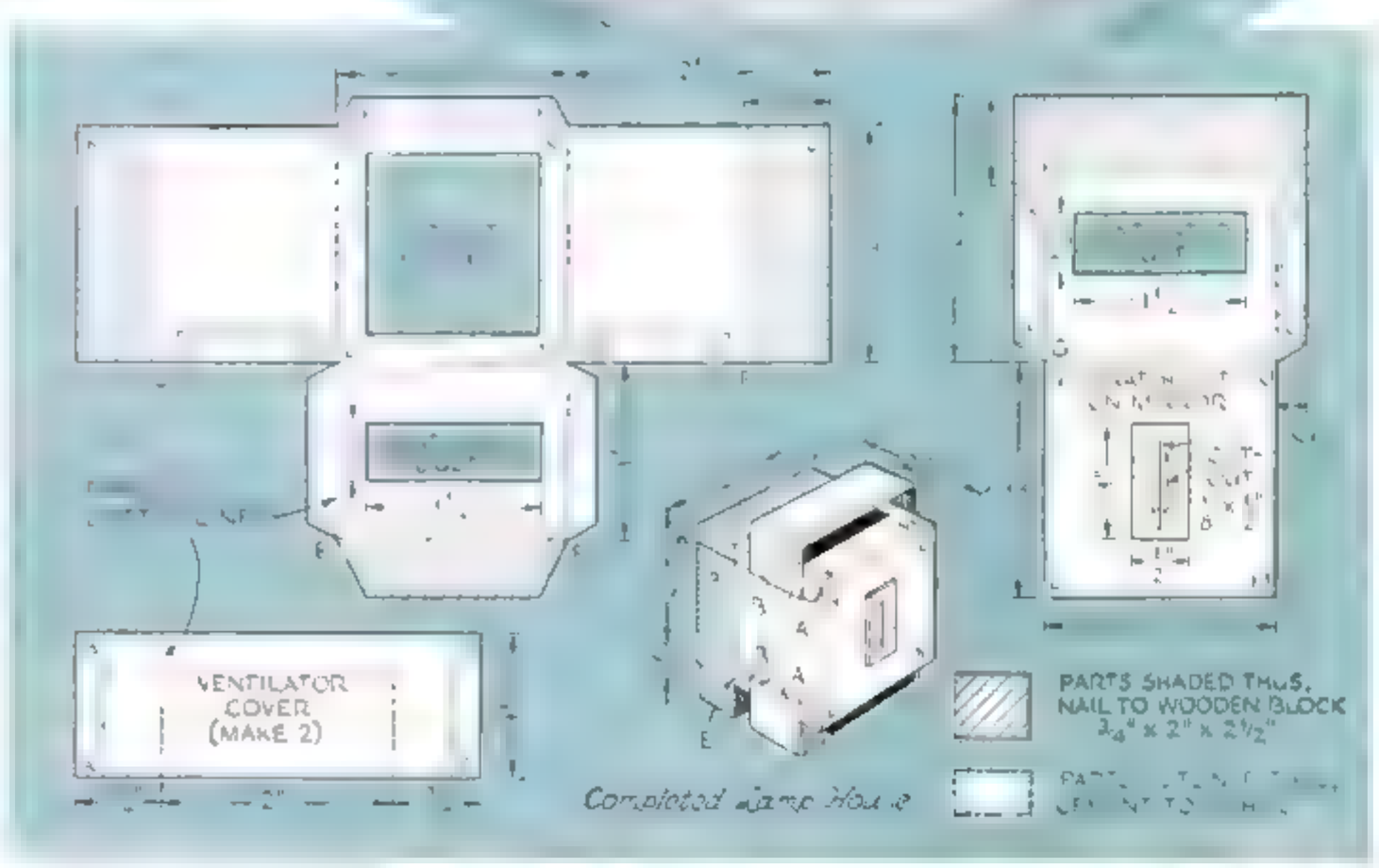
Sound Waves *in* Action

The Apparatus Costs Little to Assemble, Yet It Enables You to See Your Own Voice and Watch Graphic Motion Pictures of Radio Programs



By WALTER BACH

The parts used in assembling the oscilloscope



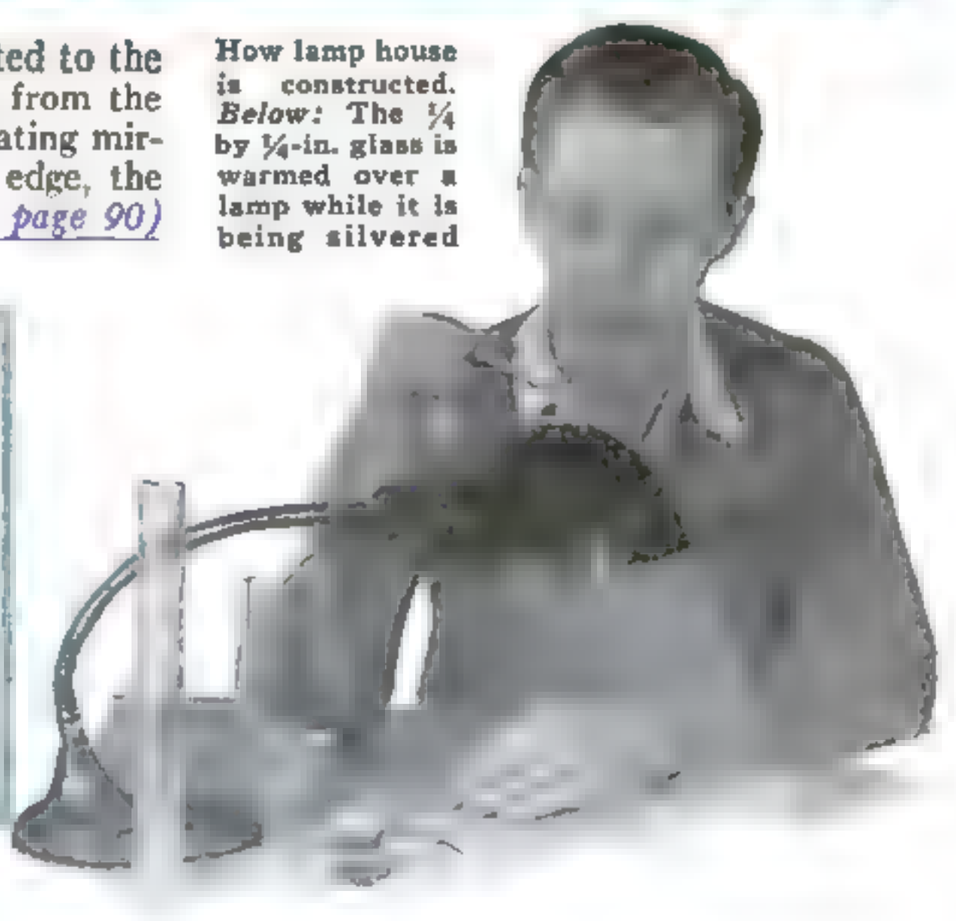
the point of a phonograph needle and carefully bending it until the glass breaks along the scratch. After polishing the glass thoroughly with a clean, oil-free cloth, silver it with the following solution: Dissolve 700 milligrams of silver nitrate in 40 c.c. of distilled water. Add ammonia water, drop by drop, until the brown precipitate, which formed at first, clears again; then add 200 milligrams of Rochelle salts. Any druggist can prepare this solution if necessary. A supporting bracket cut from sheet copper completes the vibrating-mirror unit. In the photograph at the top of this page, the unit has been removed from the bracket to show the details.

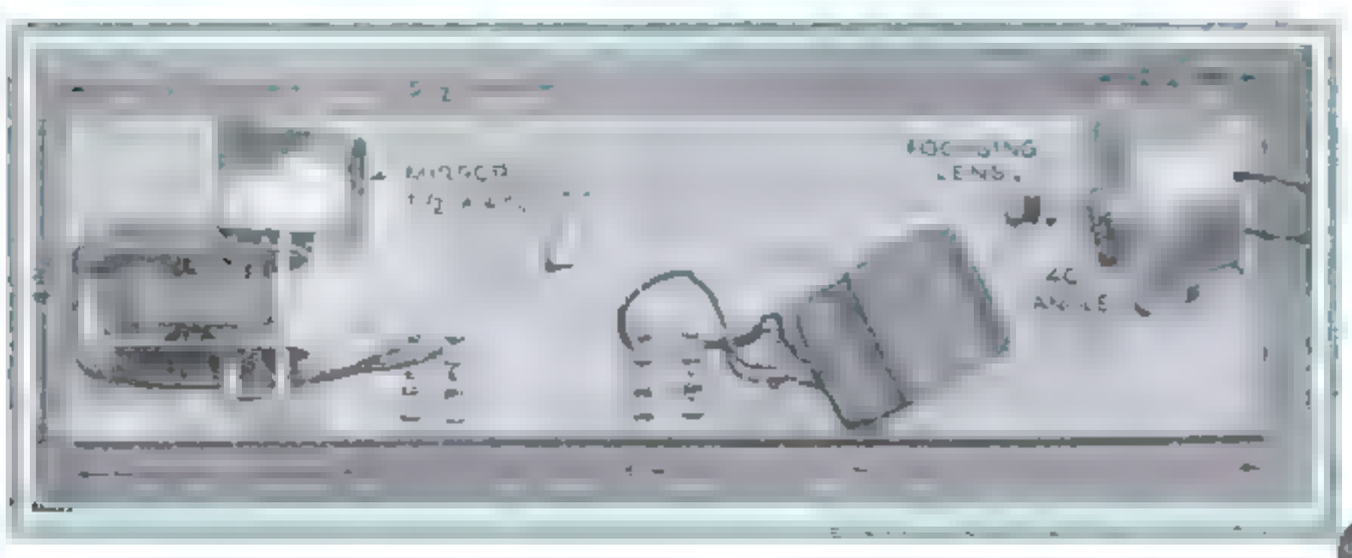
The revolving mirror is cut from an ordinary hand mirror and cemented to a wooden backing, which is attached to the shaft. The motor, pulleys, and shafting were taken from a toy construction set.

The illustrations reveal the constructional details of the scanning screen and lamp house. The lamp-house slit is produced by making a fine scratch on the silvered side of a 1 by ½-in. piece of mirror. The height of the automobile lamp filament in the lamp house, the focusing lens, and the condensing lens on the scanning screen are all determined by the corresponding height of the vibrating mirror. Measure this height from the center of the mirror to the baseboard.

The scanning screen is cemented to the baseboard with the center 1 in. from the edge of the base. With the vibrating mirror also located 1 in. from the edge, the vibrating mirror *(Continued on page 90)*

How lamp house is constructed. *Below:* The ¼ by ¼-in. glass is warmed over a lamp while it is being silvered





Top view of the apparatus. The lamp house, which may be made of thin tin or any suitable material, contains an automobile lamp and is wired for 6 volts a.c. or d.c.

SURVEY THROWS NEW LIGHT ON

Home Workshop Owner

We now know what his interests are, how much time and money he spends, and what kind of shop he has . . . All revealed by a study of the National Homeworkshop Guild

Official Magazine
POPULAR SCIENCE MONTHLY

The questionaire filled four closely printed pages and covered twenty-one different subjects

HAVE you ever wondered how you compare with the average home worker? Whether you spend more or less time and money than he does? Whether your tools and equipment are better or worse?

These are questions of immediate personal interest, but no one heretofore has been able to answer them for the simple reason that it was impossible to say with any certainty what the typical home worker is really like. Now, however, we know. A remarkably thorough survey of members of home workshop clubs has just been completed by Marvin A. Powell, of Cheyenne, Wyo., and submitted as a thesis for the degree of master of arts in the Colorado State College of Education, Greeley, Colo.

A glance at the accompanying summary of the principal findings of the survey will give you a vivid picture of the average home workshop club member. The complete report covers more than a hundred typewritten pages in length and includes twenty-six tables. Everything relating to the home workshop is revealed and analyzed.

The purpose of the study was to ascertain the value of the home workshop as a leisure activity in the lives of the members of the National Homeworkshop Guild and to show the status of the home workshop. Survey sheets containing a great many questions were printed and mailed to club members in thirty-one states and the District of Columbia. These individuals, it turned out, are engaged in 160 different vocations, including a surprising number of professional and business men, bankers, doctors, brokers, teachers, and technologists of many kinds.

Age. The largest age group is that from 25 to 33 years; next, those from 34 to 40 and 41 to 47. Seventy-three and a half percent are in these three groups, nine and a half percent are younger than 25, and the remainder are older than 47.

Education. Almost five out of six went to high school, and one out of three continued on to college. One out of every five men who replied holds a college degree. About ten percent have attended special schools of various types, and courses in shop work were taken, while in school, by three fourths of the members.

Vocations. An almost equal division between skilled workers and those who hold "white collar" positions is shown. More remarkable still is the variety of vocations, the number reported being 160. The five leading occupations in order of their frequencies are salesman, electrician, clerk, teacher, and mechanic.

Trade Experience. Forty-three percent have had work in the skilled trades. In order of frequency, the first ten trades listed are mechanic, carpenter, machinist, electrician, woodworker, printer, pattern maker, painter, plumber, and jeweler.

Home Workshop. The range of time the shops have been in existence is from one to thirty-five years, and the median length of time is four years. The majority of the shops are located in the basement, but about one out of three is in a separate building, a garage, a room of a house, or an attic. A few were reported to be in such unlikely places as offices and bedrooms. Practically all the shops can be heated and lighted.

Shop Equipment. There are five machines and approximately fifty hand tools in each shop. In counting the hand tools, a set of auger bits, a set of twist drills, and similar sets of small tools were each considered as one tool.

The machines, arranged according to frequency, are as fol- *(Continued on page 103)*

THE TYPICAL HOME WORKSHOP CLUB MEMBER

He is thirty-five years old.

His shop is in the basement and can be lighted and heated.

He spends eleven and a half hours a week in his shop.

His shop equipment consists of five machines and fifty hand tools.

He has invested $190 for tools and machines.

He spends $12 a year for wood, tools, hardware, paint, metal, and miscellaneous supplies.

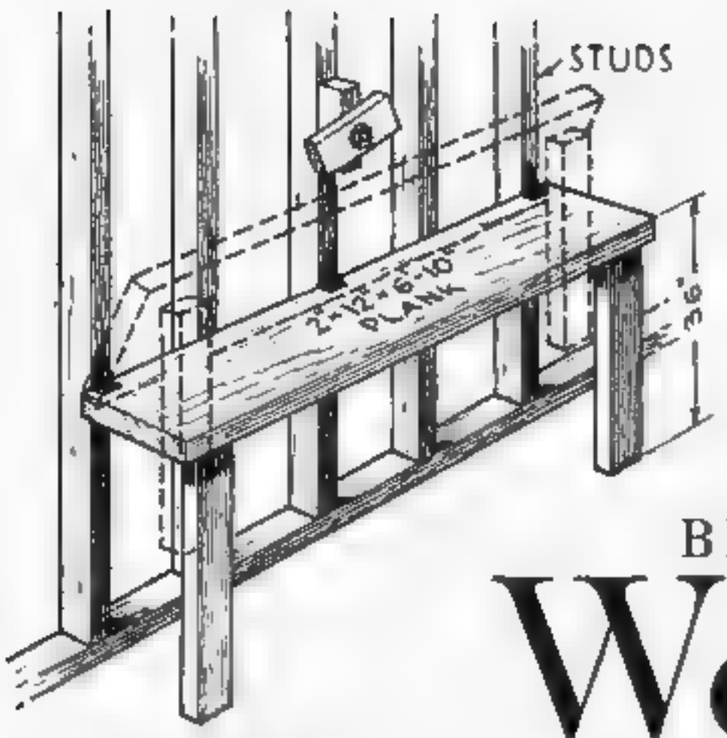
He may follow almost any vocation under the sun, from bank president to laborer. The list of occupations reaches the amazing total of 160.

More often than not he has never worked in a skilled trade.

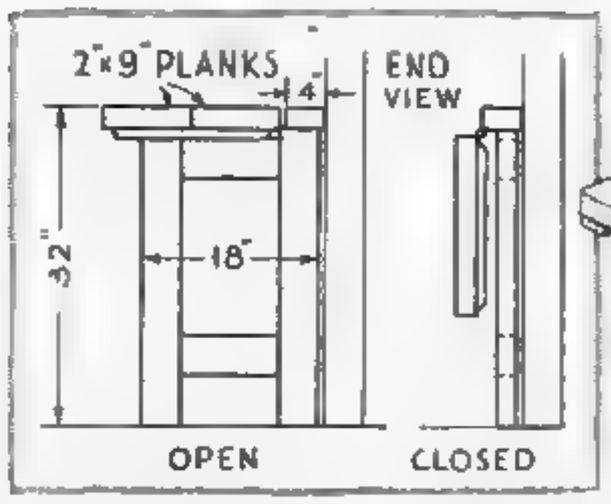
His education is better than average. It is almost a one-to-two chance that he went to college and a one-to-four chance that he holds a college degree.

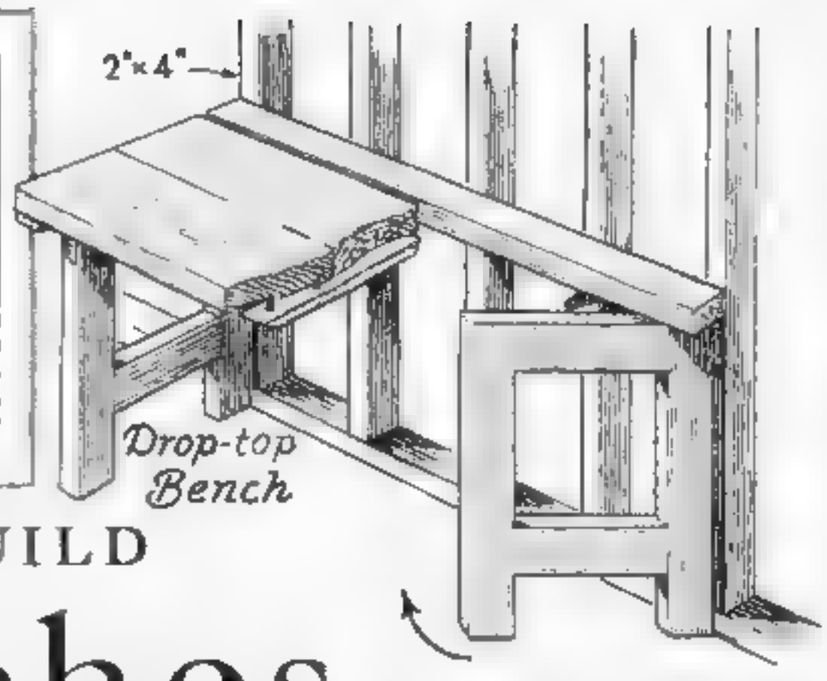
He maintains his shop principally for enjoyment, but partly for making repairs and other profitable work.

He is an inveterate magazine reader. POPULAR SCIENCE MONTHLY is his favorite magazine.



Folding Bench for Narrow Garage



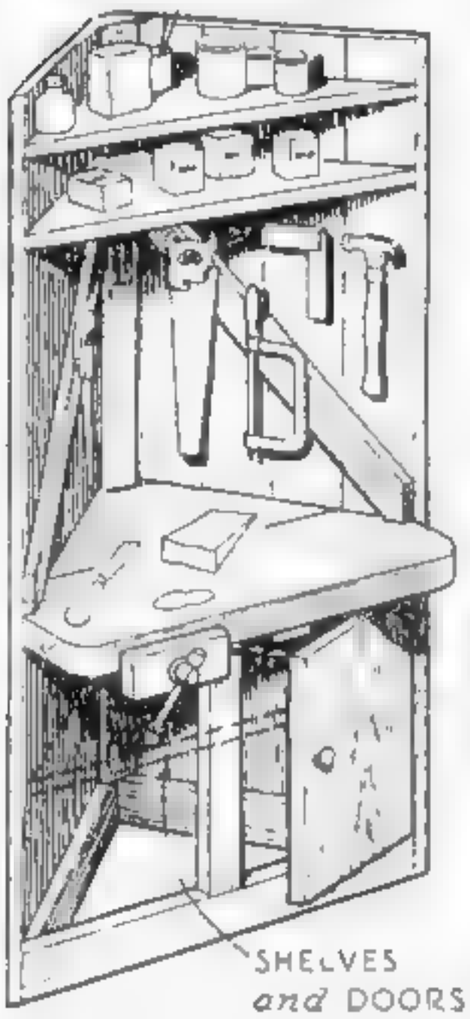


Drop-top Bench

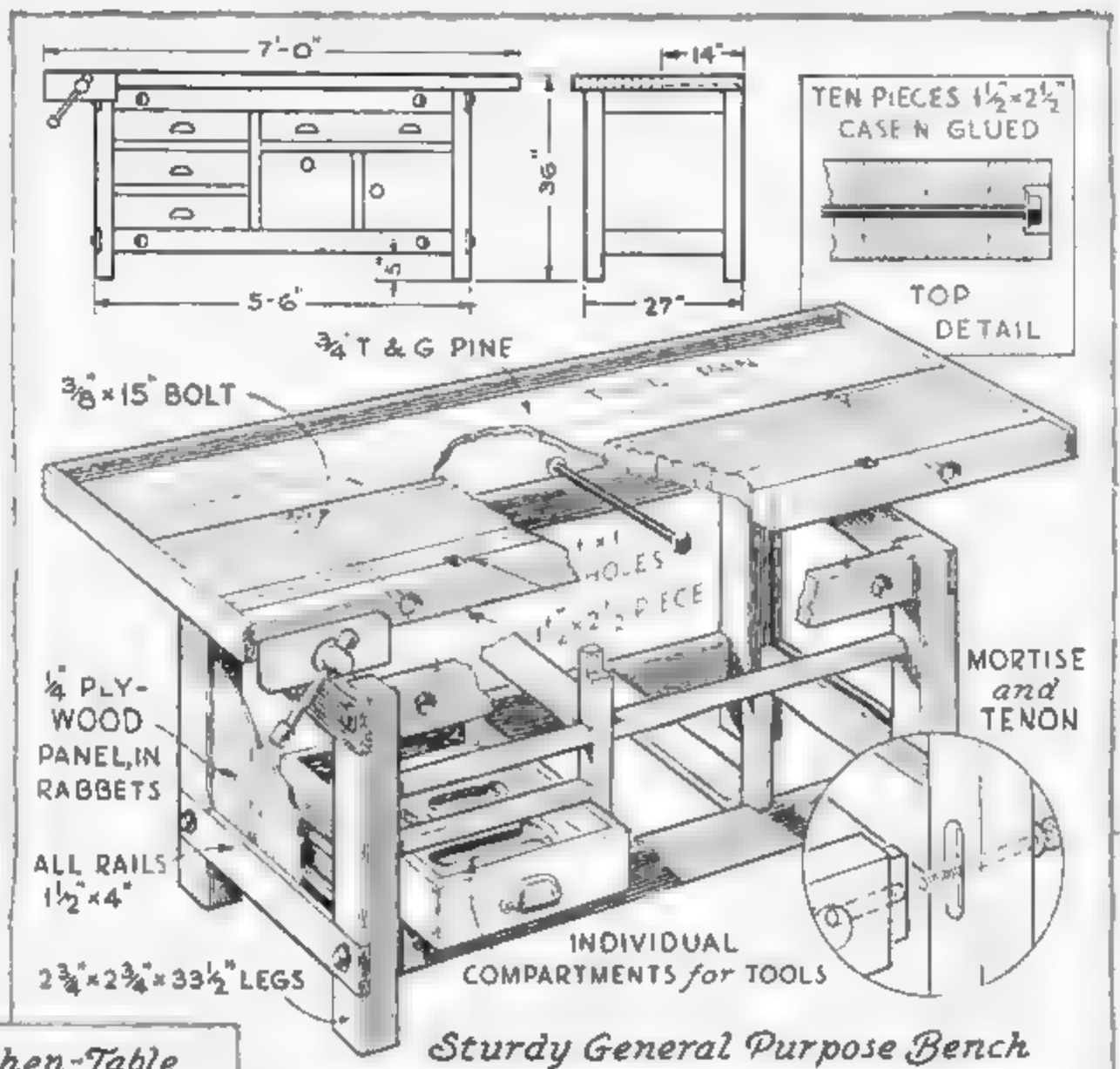
BETTER WAYS TO BUILD

Workbenches

A page of hints by HI SIBLEY

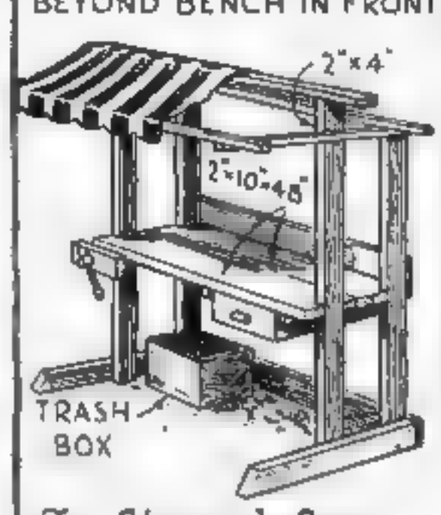


Portable Corner Work Cabinet for House Use

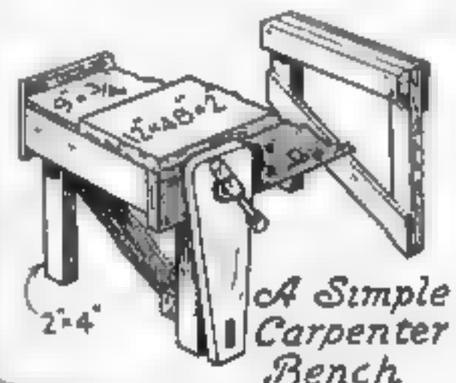


Sturdy General Purpose Bench

AWNING EXTENDS 18" BEYOND BENCH IN FRONT

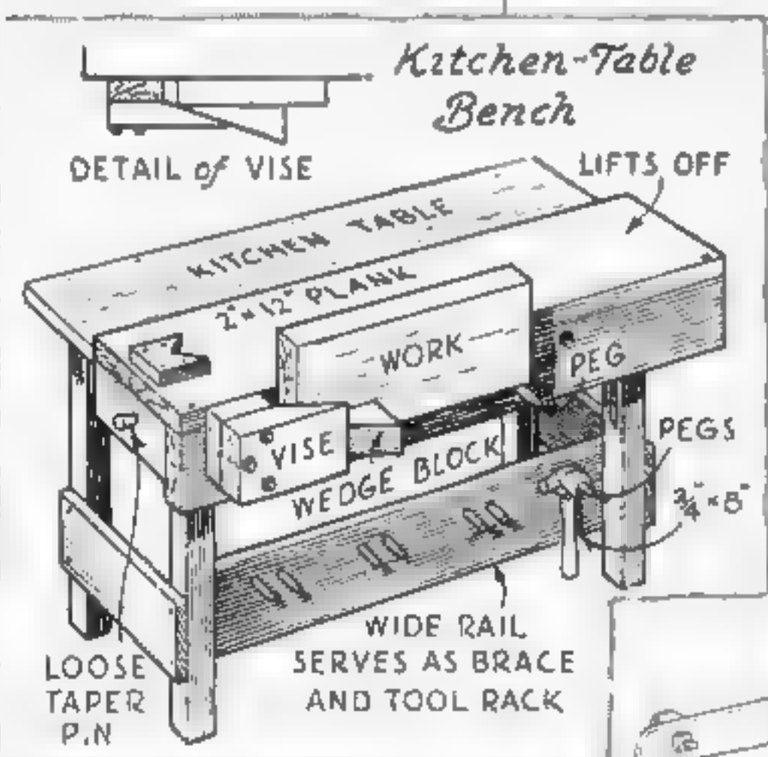


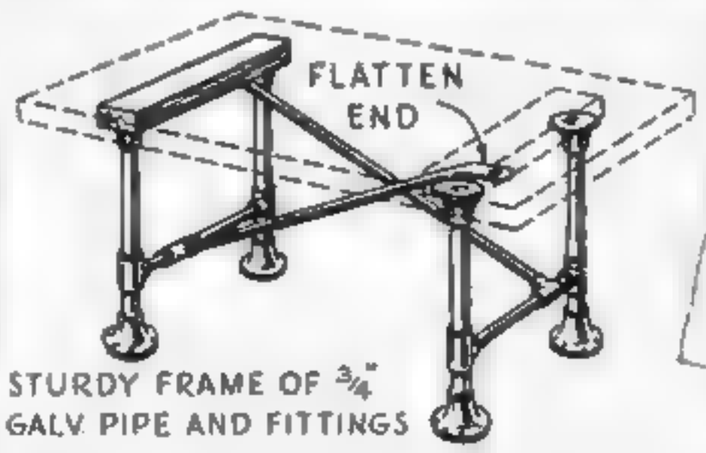
For Unused Space Alongside Driveway

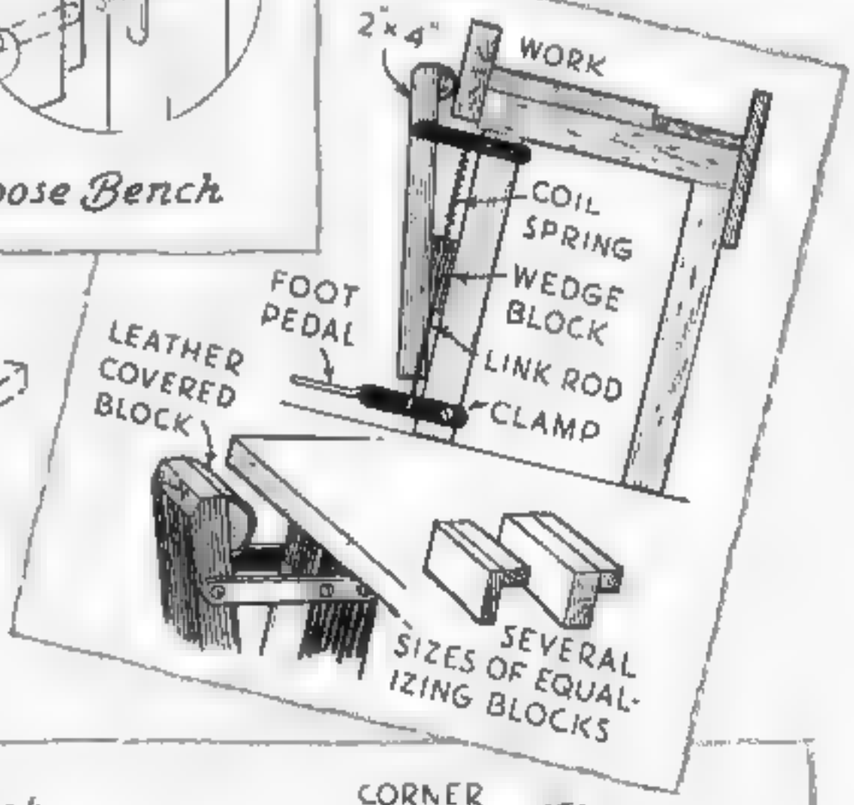


A Simple Carpenter Bench

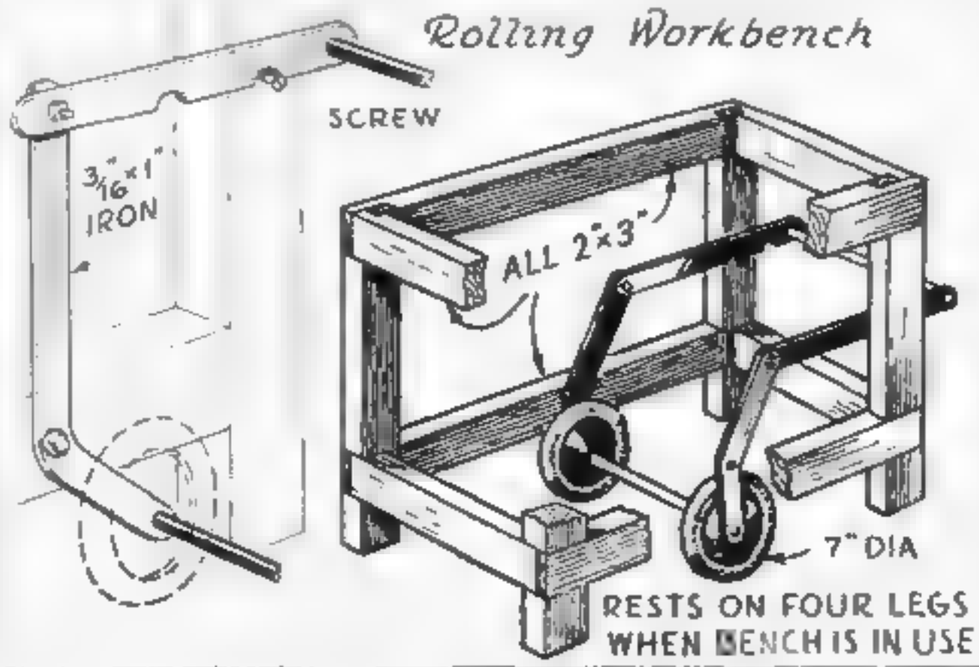
Kitchen-Table Bench

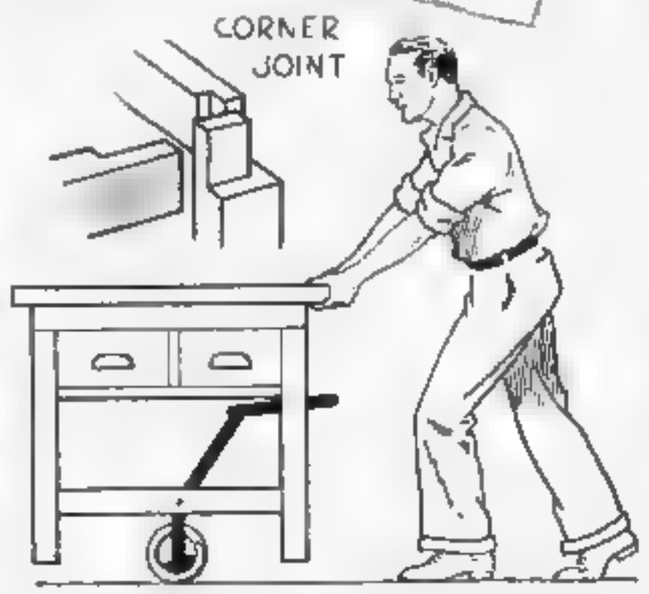




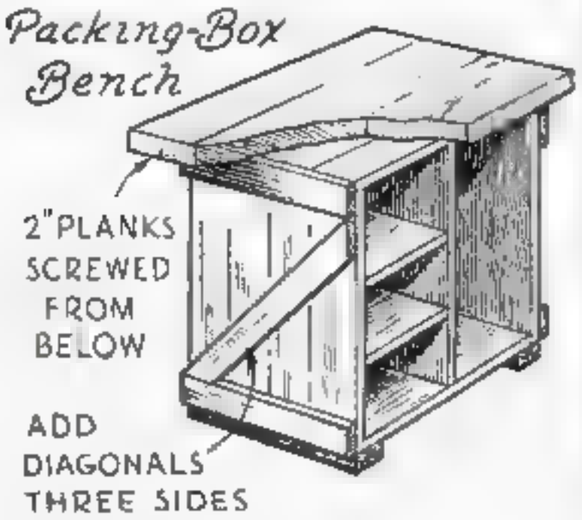


Rolling Workbench





Packing-Box Bench



Are you using our blueprints? See list on page 86.

A DAINTY

Dressing Mirror

You can learn a lot about fine cabinetmaking by constructing this beautiful little piece . . . and without spending much for materials

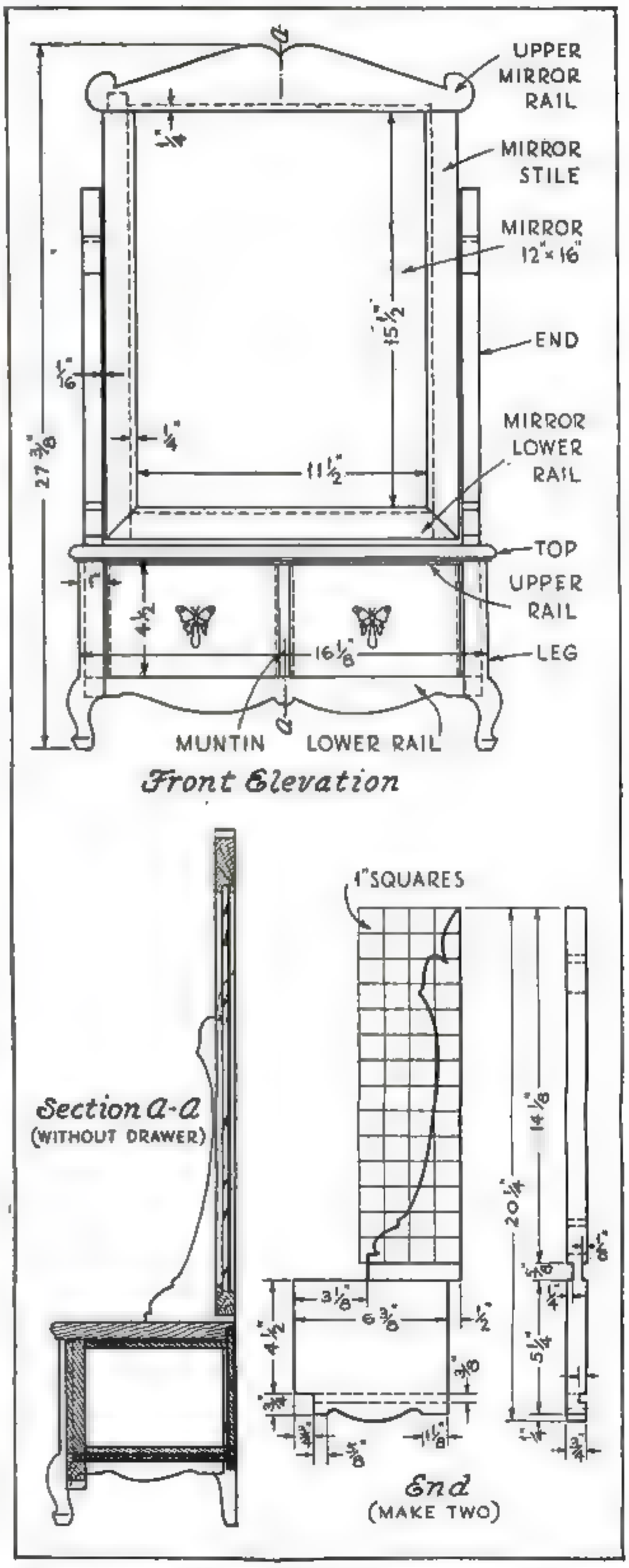
By
EDWIN M. LOVE

PLACED on an end table, a low chest of drawers, or some other piece of furniture, this decorative little dressing glass provides not only a mirror of usable size but also two small drawers for handkerchiefs or gloves. It therefore makes an excellent gift.

Walnut, mahogany, and maple are desirable for making this piece, but any good cabinet hardwood may be used. The ends are cut from a piece of 1 by 10 in. stock 22 in. long. Shape roughly and joint up the back edges for use as face edges. On one piece square a line across the face side ¼ in. above the lower end. Lay out the ¾ by ¾ in. rail notch in the front edge, and draw the bottom curve, which begins 1⅜ in. from the front edge and ends 1⅝ in. from the back edge. Square another line across the face of the stock 5¼ in. above the first line, and a third, ⅝ in. above the second; these locate the dado for the top of the box. Lay out a similar dado on the opposite side as shown, and a ⅜ by ¼ in. dado on the inner side near the bottom where indicated.

Make a cardboard pattern for the upper end by dividing a 4 by 14½-in. strip into 1-in. squares. On these squares mark the outline intersections and draw smooth curves through the points. Cut out the pattern and trace the outline on the stock. Saw out the profile and cut away the waste material along the lower side of the dado, making a 3⅛-in. offset. Cut the rail notch, rip ½ in. off the back edge up to the dado; then dado the outside ¼ in. deep, and the inside face, ⅛ in. The piece should be well smoothed and sanded. The other end can be traced directly from the first, but must be dadoed so as to make a pair, one right-hand and one left-hand.

For the top, surface to ⅝-in. thickness a piece of stock 1 by 8 by 17 in.; then square it carefully to 7½ in. by 1 ft. 4 ⅞ in. Make a ⅛ by ⅛-in. rabbet in the underside on the front edge and both ends, and round the edges to an elliptical profile as shown in the detail drawing of the top. On the underside, 1⅛ in. from each end, gauge a line, and gauge another ⅝ in. from the front edge. Rabbet the back edge ⅜ by ⅜ in. to within 1 in. of each end. Make four ⅛ by ½-in. strips 5¾ in. long. Glue these to the top, and nail with brads—one near each end, the outer edge guiding on the the line, and a pair ½ in. apart at the center. Glue a similar strip to butt *(Continued on page 96)*



A front view of the assembled dressing mirror, a sectional end view (drawers omitted), and face and edge views of the two ends

Pocketknife Scotties

How to Whittle Six Decorative Little Dogs, All Variations of One Simple Pose

By E. J. TANGERMAN

SANDY

Sandy and his two pals, Rob and Mac, are shown in individual photographs, and all six dogs appear in the drawings. The view at the right shows how Sandy's body is rounded

ROB

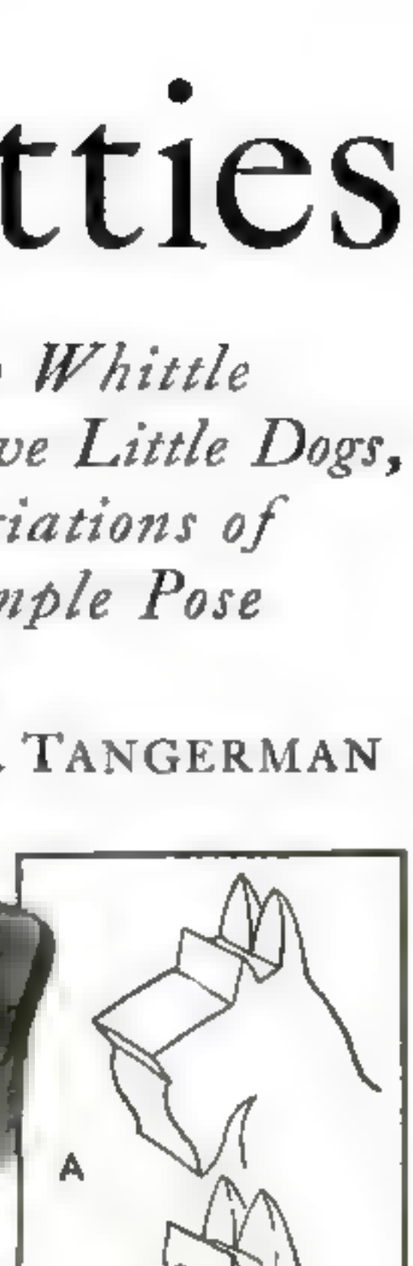


FIG. 2

MEET Mac, Sandy, Rob, Tam, Jock, and Lad, a double threesome of the bonniest Scotties that ever romped the heather. They're braw dogs every one, and so, lads and lassies, here's how to whittle them in miniature from wood. It'll be easier than you think because they're all variations of one simple pose.

All you'll need is a good-sized piece of 1-in. softwood, preferably white pine or basswood, planed on both sides so its actual thickness is about ¾ in. Mac takes a block of this 2 by 2⅛ in., Rob 2 by 2¼, Sandy 2 by 2½, and Tam, Jock, and Lad 2 by 2⅛ each. Select blocks that are straight grained and without knots, and on one flat face draw ¼-in. squares. On these checkerboards lay out the patterns of Fig. 1. My preference is to let the grain run lengthwise from nose to tail, but beginners may find the other way better since the tips of the ears are less likely to break.

With either knife or scroll saw, cut away the block along the lines of the pattern. Stop and study the photographs of the finished dogs, then begin to round off roughly the sharp lines of the back, stomach, and legs, and thin and round the tail. (One photograph shows this rounding operation being performed on Sandy.) Separate the ears and round them in back (see Fig. 3B), and cut along the line of the lower jaw and up the front of the leg to take out a V and thus form the neck.

Now you're ready to carve the face by the steps shown in Fig. 2. Study the sketch marked *B*, then cut in the forehead and take off the beveled strip of wood on each side of the head to form the upper part of the nose, and take out the wedge of wood between eyebrow and ear. To form the dewlaps or prominent lower lips and chin whiskers which Mac sports, hollow out the lower jaw as at *C*. This figure also shows the formation of the nostrils by a cut straight in from the side and a long bevel up from the bottom of the chin. Next hollow out the ears slightly and hollow out from the inside of each dewlap toward the front of Mac's nose, as you can see at *B* and *D*.

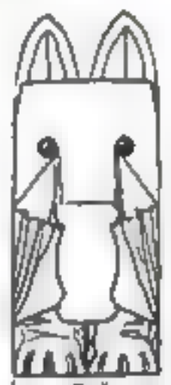
The pup will now look quite a bit like the Scotties you see running around town, but a few careful knife cuts are needed to take out the V's of wood that give Mac his appearance of rough coat and whiskers. Study Fig. 3A for the position of these cuts. Three sprout on each side from the base of the tail, three run parallel below the base of the ears, and a couple just ahead of the hind leg and just back of the foreleg accentuate the curve of Mac's belly

A couple of V's, one cut along the front line of the foreleg and the other along

(Continued on page 90)

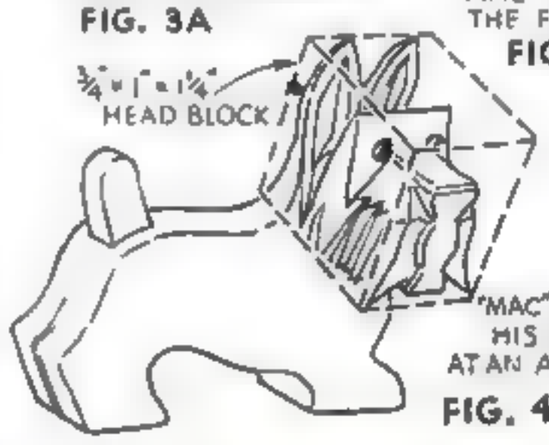
V-CUTS GIVE "MAC" HIS SHAGGY APPEARANCE

FIG. 3A



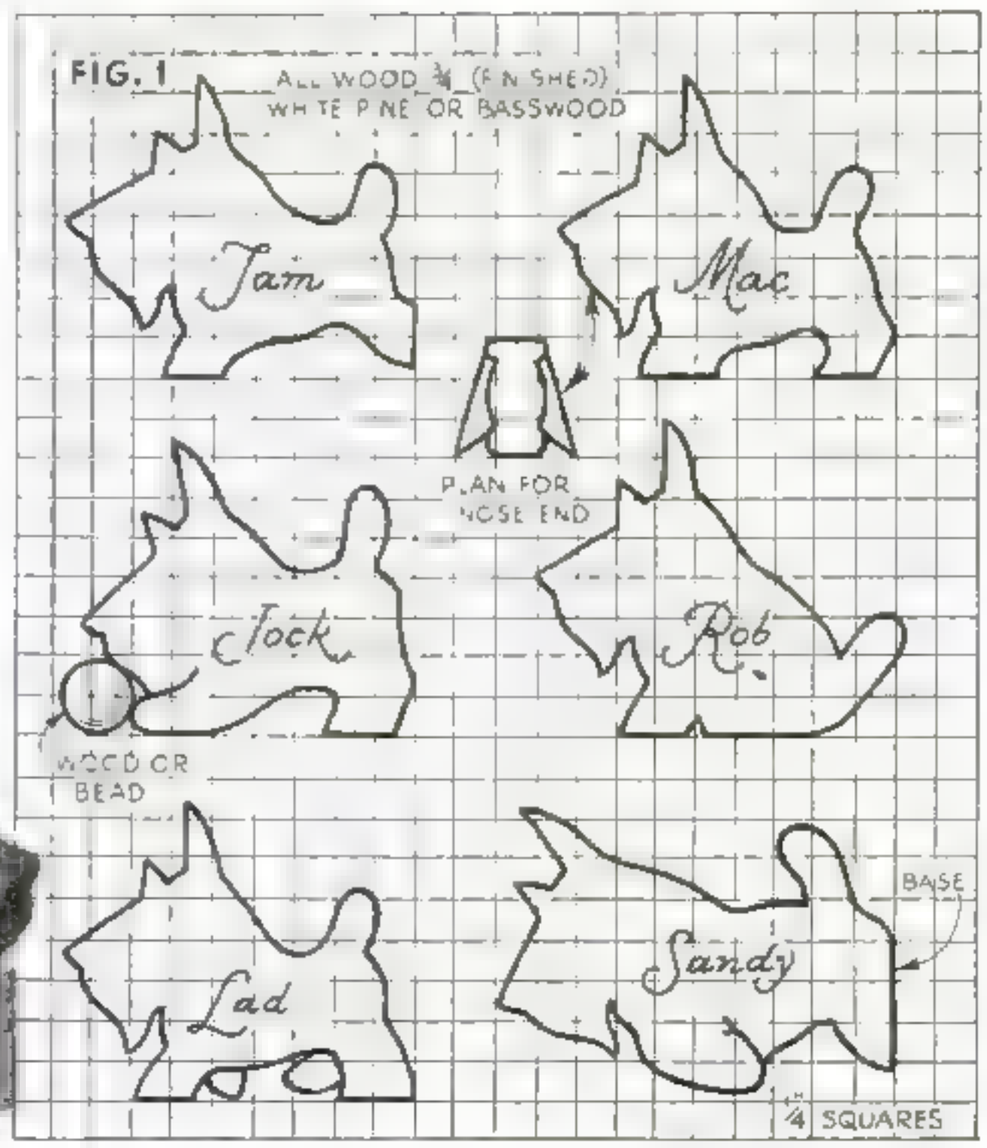
"MAC" FROM THE FRONT

FIG. 3B



"MAC" WITH HIS HEAD AT AN ANGLE

FIG. 4



MAC

THE ART OF MAKING Lifelike

MARIONETTE bodies may be made in several ways for use with heads of the type described last month (P. S. M., Jan. '36, p. 57):

1. Sewed and stuffed with kapok or cotton, and weighted.

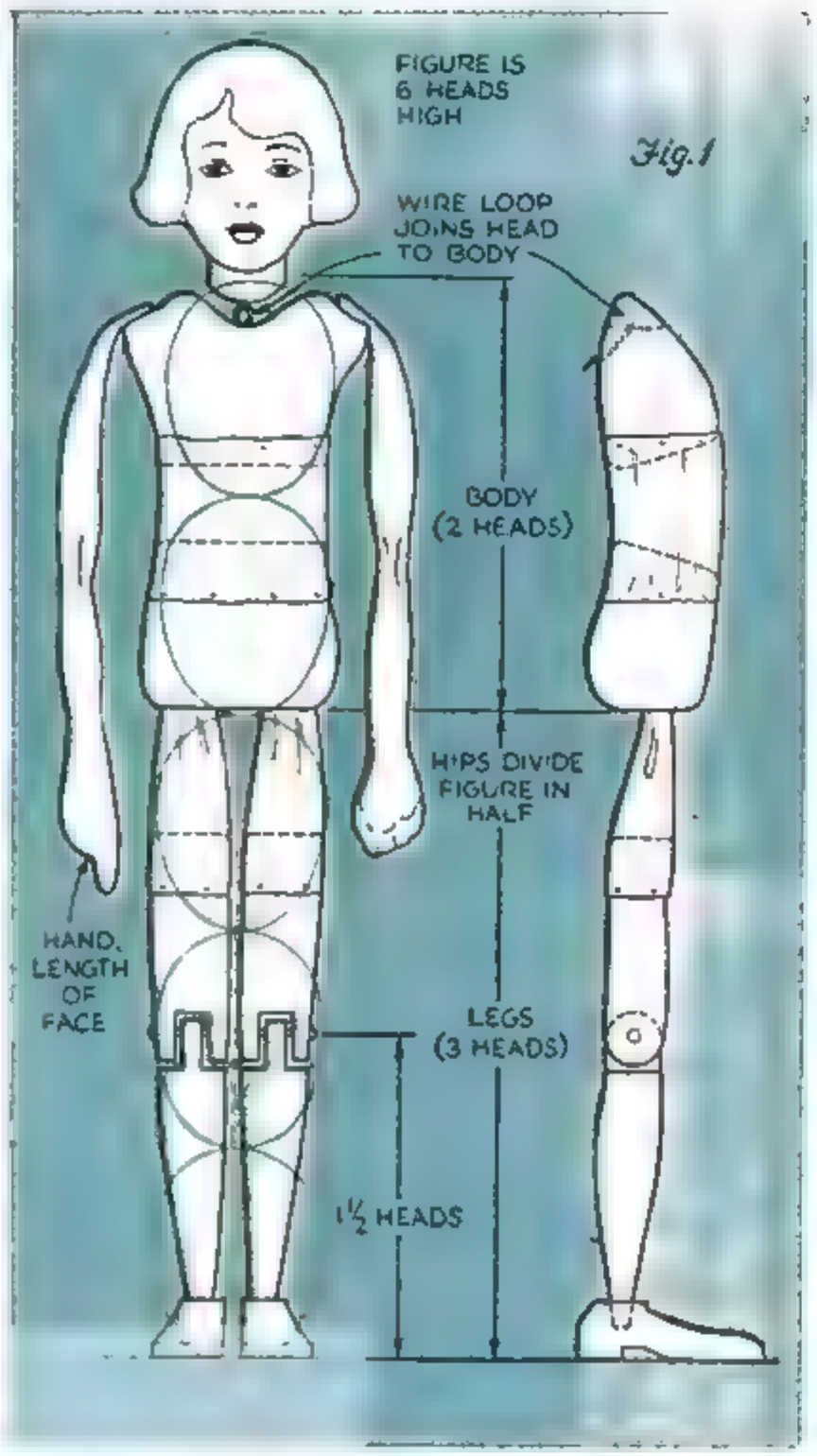
2. *Papier-mâché* shell bodies, filled and weighted.

3. Of wood (scrap pieces and dowel sticks) whittled to shape.

4. Best of all, carved from softwood, but this takes more knowledge and artistry than the others and therefore should follow experiments with one of the simpler methods.

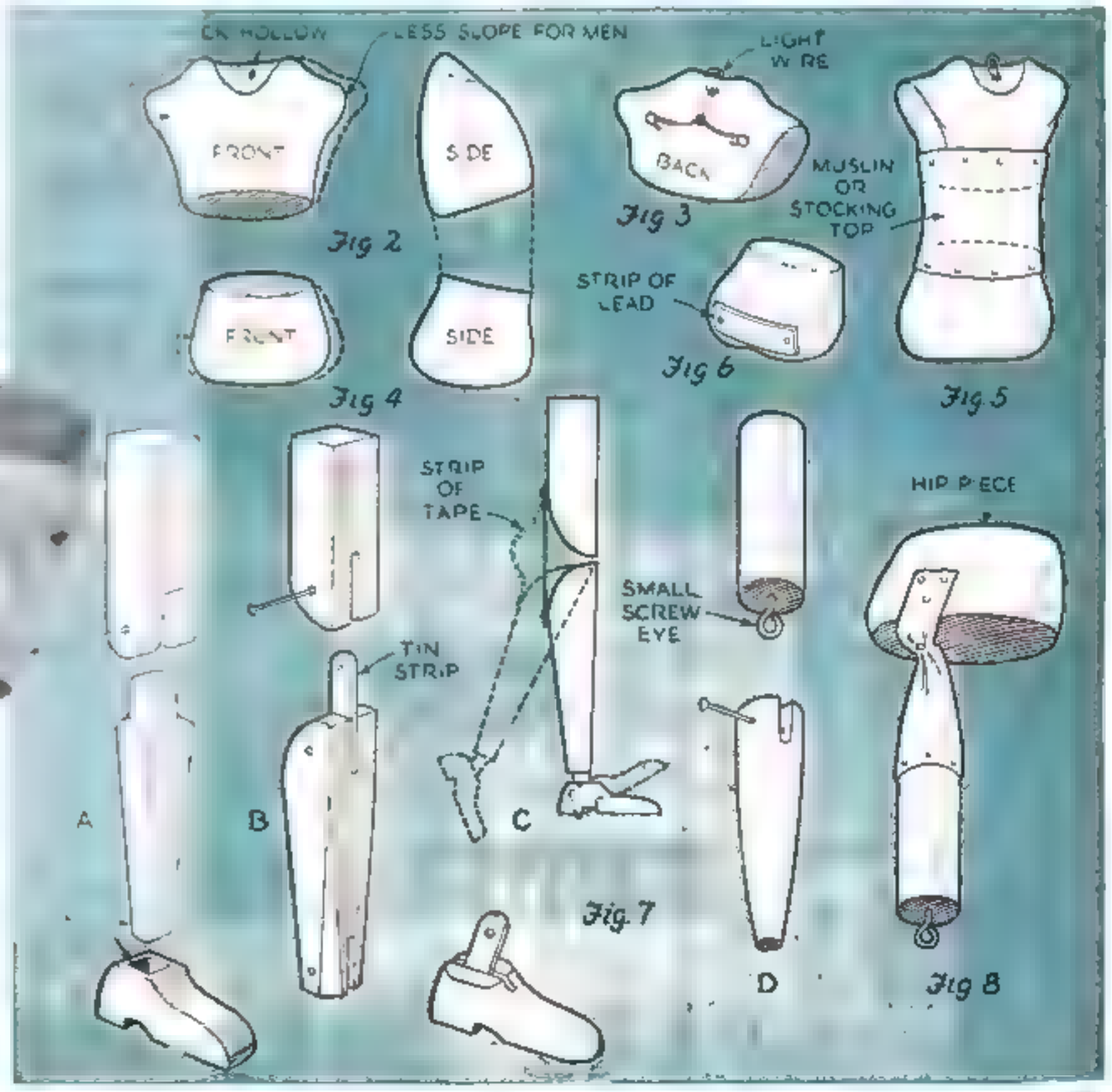
In this article the third method will be described. It is a practical way to make the average puppet, but, of course, not all puppets. Every puppet is an individual problem and should be regarded as such. Give it the characteristics called for in its part in the play. Consider the proportions, weight, and gestures. Do not be too realistic, however; poor imitation is not art. Elimination of nonessentials is important. Simplify everything.

For the normal figure, puppets are about six heads tall. The body is two heads long, and from hips to feet is three heads. This one-two-three proportion is easily remembered. The hips divide the figure in half. Hands and feet are equal to the length of



Front and side views of a typical marionette body. The puppet at right is Woggle Bug from "Wizard of Oz"

Duchess and baby from Mrs. Drake's set of marionettes representing characters in "Alice in Wonderland." The heads are modeled from newspaper pulp as described in an article published last month. The body construction is as illustrated by the sketches



Marionette Bodies

Materials and tools . . . Various types of joints . . . Costuming . . . How to string puppets . . . Hints on their manipulation

By Florence Fetherston Drake

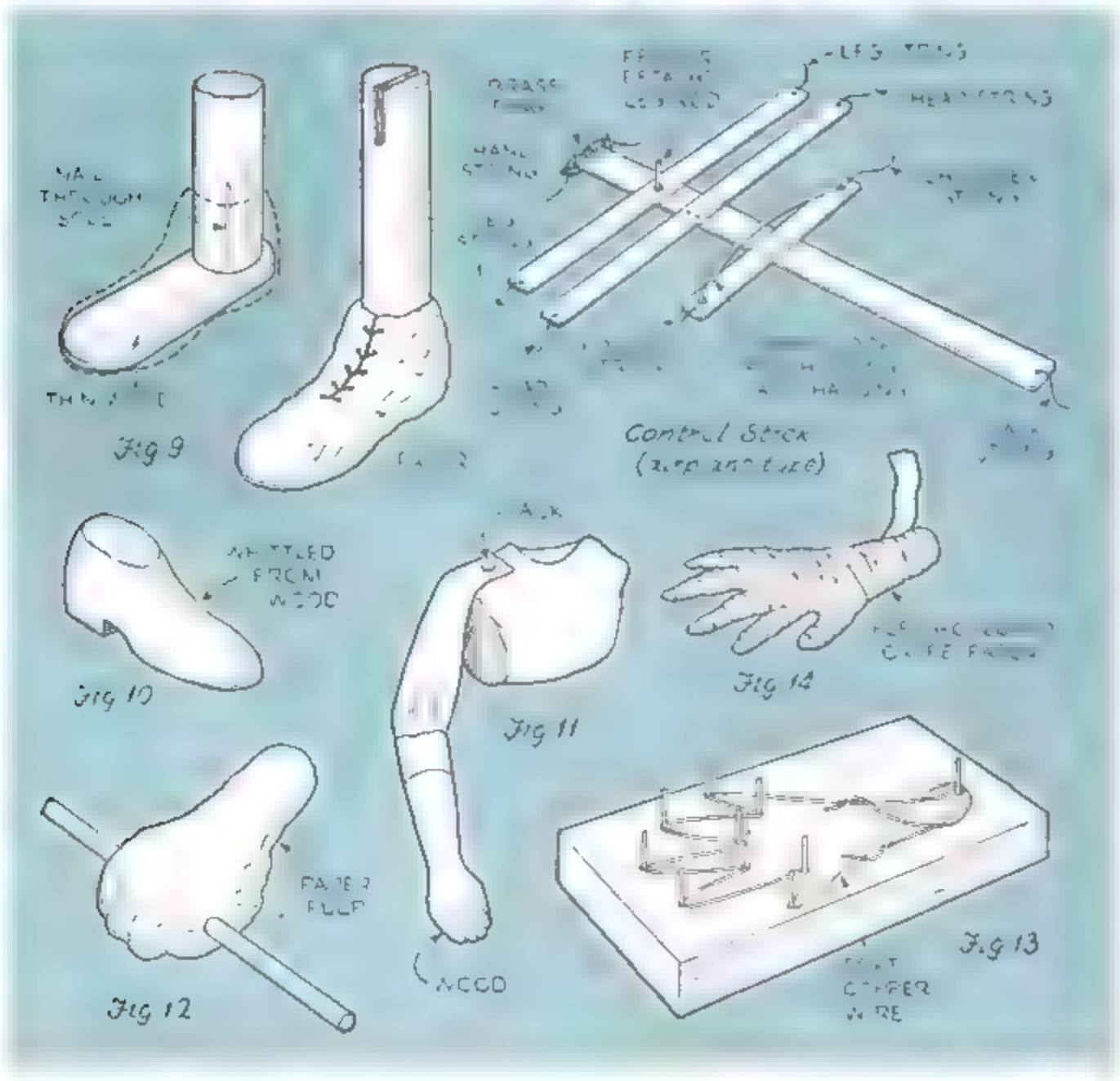
In the spotlight are figures of Thomas Jefferson and Benjamin Franklin. The puppet at the left—William's son from "Alice in Wonderland"—requires a controller like that shown just below it

the face from the hair line on the forehead to the chin. Legs are divided into three parts: thigh, leg, foot. Leg and thigh are about the same length—one and a half heads long. Upper arm and forearm are practically similar. The width of the hips is more than the width of the shoulders in women's figures; less in men's figures. In making a lean figure, exaggerate the thinness; in a fat one, exaggerate the width. A glance at any group of Tony Sarg's figures will show what is meant.

Since all properties and stage settings must be made to the same scale as that used for the puppets, it is important to adhere to a certain scale. If an 18-in. puppet is used to represent a figure 6 ft. tall, the scale is, obviously, 3 in. equals 1 ft. If the puppet is 15 in., the scale is 2½ in. equals 1 ft.; if 12 in., the scale is 2 in. equals 1 ft.

The size of a puppet depends upon where it is to be shown. One third the height of the proscenium is good. From 15 to 24 in. is the average height. When puppets are larger, much of the illusion is lost and they become difficult and awkward to operate.

Make a rough sketch of the figure you intend to copy—front and side views. No matter how crude this may be, it will help.



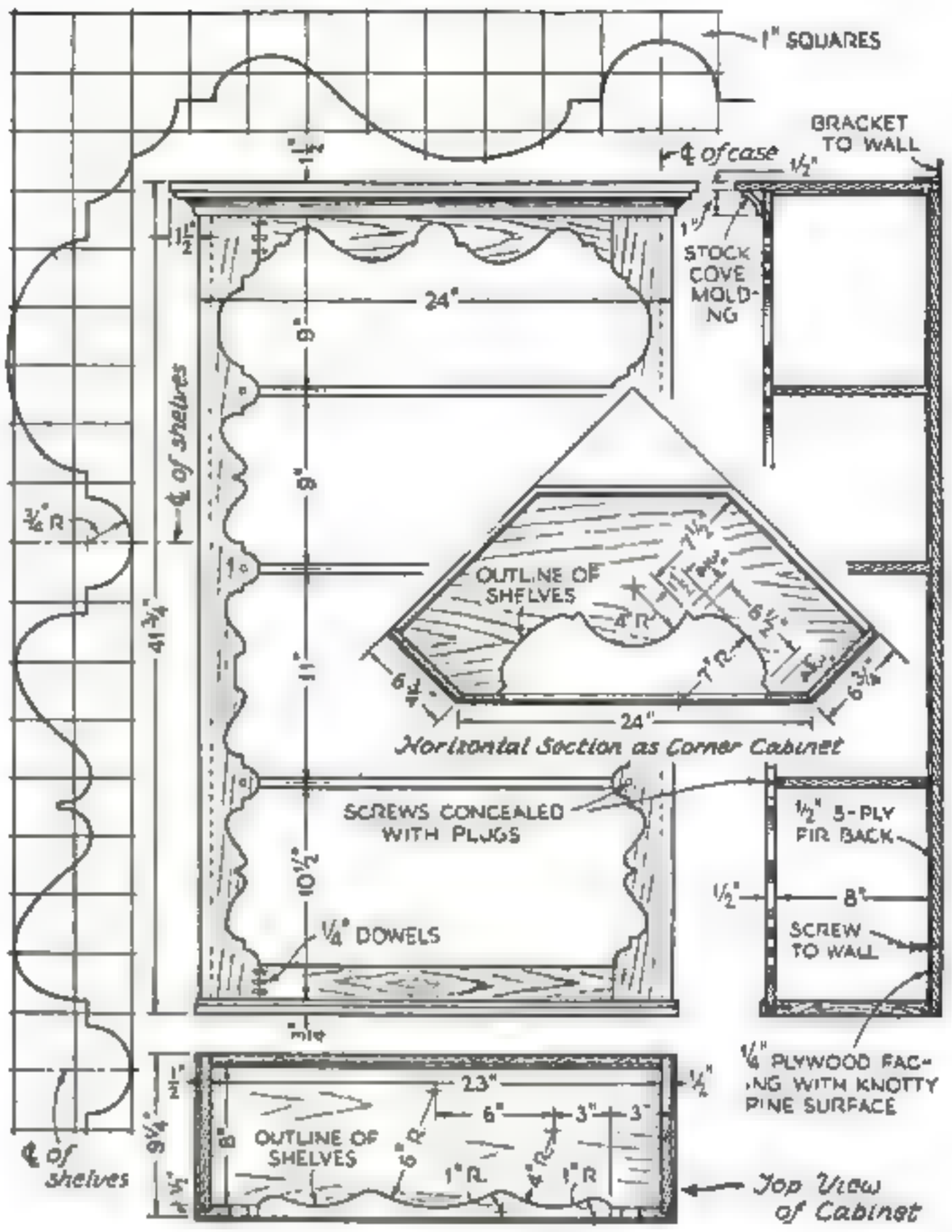
Soft white pine is the wood to use. At almost any lumberyard you can buy, for a dime or two, odds and ends of wood that serve the purpose admirably. You will also need ¾- and ⅜-in. dowels; small and medium tacks, brads, and nails; very small and medium screw eyes, commonly designated as 217½ and 215½; fine and medium sandpaper; a sharpening stone or emery for keeping a keen edge on your knife; adhesive tape; narrow tape for the back of knee joints to prevent the legs from bending forward; spools of No. 20 copper and No. 16 tinned wire; small pieces of thin tin or brass for hinges; muslin for joining hip and shoulder pieces and legs to hip piece; and sheet lead, dress weights, or sinkers to weight figures.

The essential tools are: coping or fret saw, small and medium size hammers, pocketknife, chisel, awl, small gimlet or hand drill, flat and round-nosed pliers, flat and round files, razor blade and holder, scissors, ruler, vise, and clamps.

The wooden parts need not be finished too carefully except in cases where the arms, calves of legs, or perhaps the neck are exposed. All parts should have the edges rounded and be sandpapered to prevent cutting through the costume and to assure smooth action. Tack a piece of sandpaper around the end of a block of wood about 1 by 2 by 8 in., and another piece around a portion of an old broom handle; these will be helpful in finishing your work. Hold *(Continued on page 109)*

Five Most Novel

HAND PICKED



Working drawings for the hanging cabinet. Note the extra view that shows how to adapt the design for building a corner cabinet

PINE HANGING CABINET FOR CHINAWARE DESIGNED IN EARLY AMERICAN STYLE

THIS decorative pine hanging cabinet for cherished pieces of glass and chinaware was modeled after an old-time corner cabinet, which was built in place with a cupboard below. It may be constructed in the same way, as indicated in a sectional plan view given on the drawing, or it may be made up as a plain hanging wall cabinet, as shown in the other details. The deeply scalloped shelves are a feature of the corner-cabinet variation, while the flat cabinet has, of necessity, shallower indentations. The height from the floor should be from 24 to 30 in.

While pine is suggested as an appropriate wood, it would be entirely in keeping to use maple for the shelves and sides because of its greater strength, and to line the back with knotty pine. A piece of ½-in. thick five-ply fir plywood makes an ideal back to which the rest of the parts may be screwed. However, if the knotty pine is not obtainable in thin stock or plywood, the back may be built up from ¾-in. pine boards, well joined and glued.

Where the heads of the screws used in fastening the parts together would be visible, they are countersunk and concealed with flush plugs. The cornice molding is a stock shape.—DONALD A. PRICE.

STEEL BASE SUPPORTS MODERN STAND

IN THE modern stand, illustrated at the right, is combined an interesting variety of inexpensive materials. The base is a short section of channel shape taken from an old automobile. A piece of wide pressed-steel auto frame is easily picked up in an auto wrecking yard, but a piece of regular structural steel of channel section could be used. An alternative would be to use a piece of wood 1¾ in. thick. If channel steel is used, cut it to length with a hack saw and file the ends smooth and square.

For the legs or curved uprights, of wrought iron preferably, cut wrought iron of the size given in the list of materials to the proper length and mark a point midway in its length. From this point mark off the points where the bends start. Grip the flat portion in the vise with one of these marks exactly at the end of the vise jaw. Then grip the part to be bent and swing it almost to a right angle. This should make the proper curve at the bend. If the curve has too much of a sweep, hammer it to a sharper *(Continued on page 93)*

The framework is painted metal; the top, a piece of plywood finished in another color

TINY SAILS FORM SHADES ON CANDLES

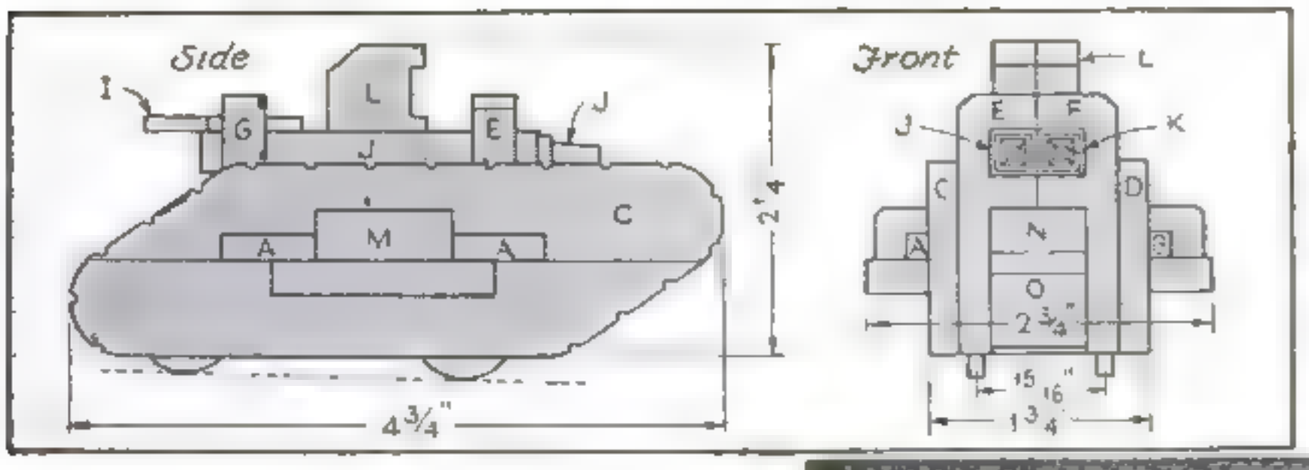
FOR a room with a nautical atmosphere, good-looking shades to fit electric or wax candles can easily be made in the likeness of a galleon's sprit topsail.

A pair of candle-shade clips are needed; these can usually be found in a ten-cent store. Cut off all but the clip itself and about ¾ in. of the projecting bar, to be inserted in the bowsprit.

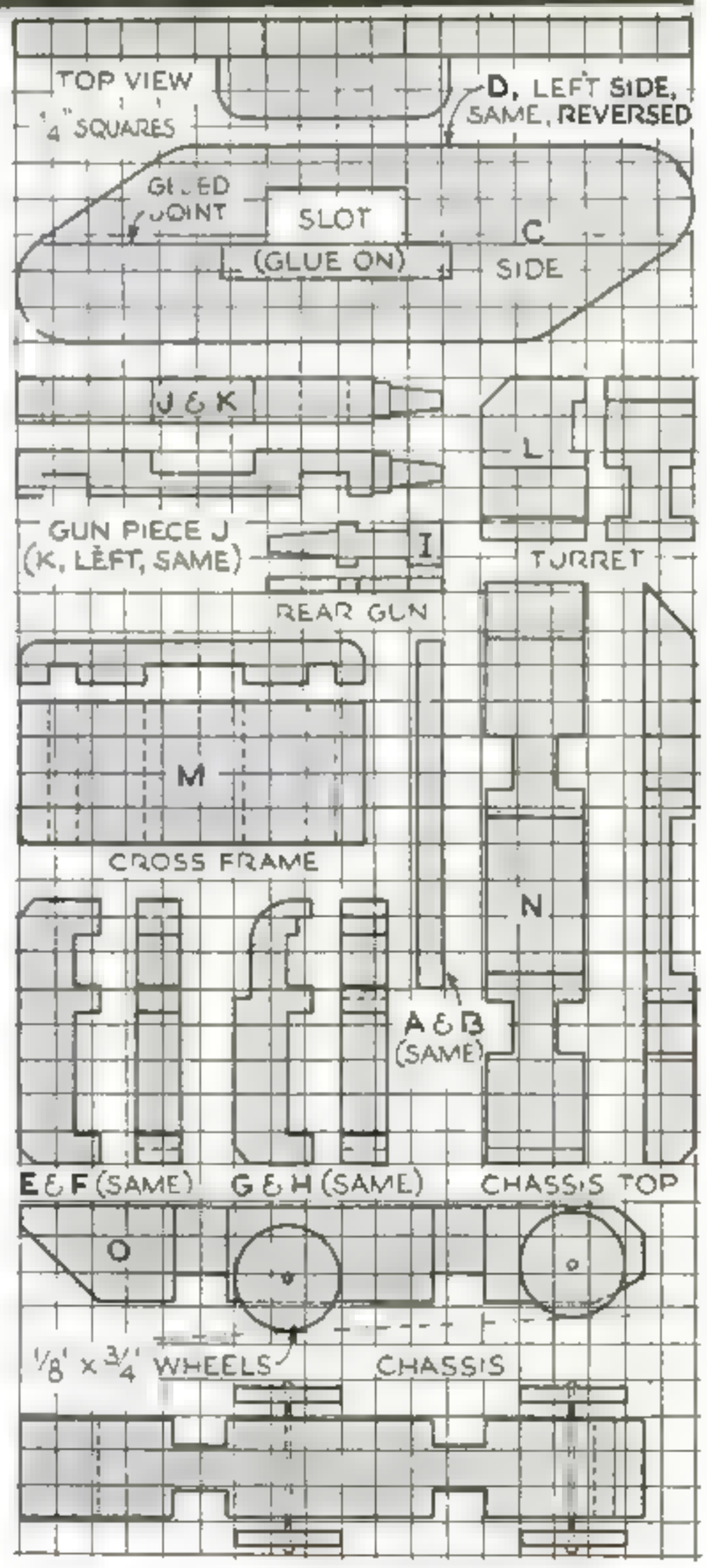
Make the masts from a 3/16-in. dowel. They should be tapered from the point where the round tops are placed out to the end. In the lower end of each cut an oblong slot at a slant, and in these fit the end of a piece of dowel 1⅜ in. long, to represent the end of the bowsprit. In the other end of the *(Continued on page 85)*

Craftwork Projects

FROM A HUNDRED SUGGESTIONS



The assembled puzzle, the parts, and diagrams giving the shape of each piece



BLOCK PUZZLE SHAPED LIKE BATTLE TANK

THE familiar Chinese cross puzzle appears in novel new guise in this little battle tank, which also originated in the Orient. It affords an opportunity to try your skill at whittling. There are fifteen units, most of them single pieces. The chassis, however, has four wheels on a single block, and the side plates *C* and *D* have a platform on the side, glued just below the slot. To facilitate cutting the rectangular slot, the side plates can be built up of two pieces glued together.

Soft pine is easy to work, but a more attractive puzzle can be made from some close-grained hardwood such as maple.

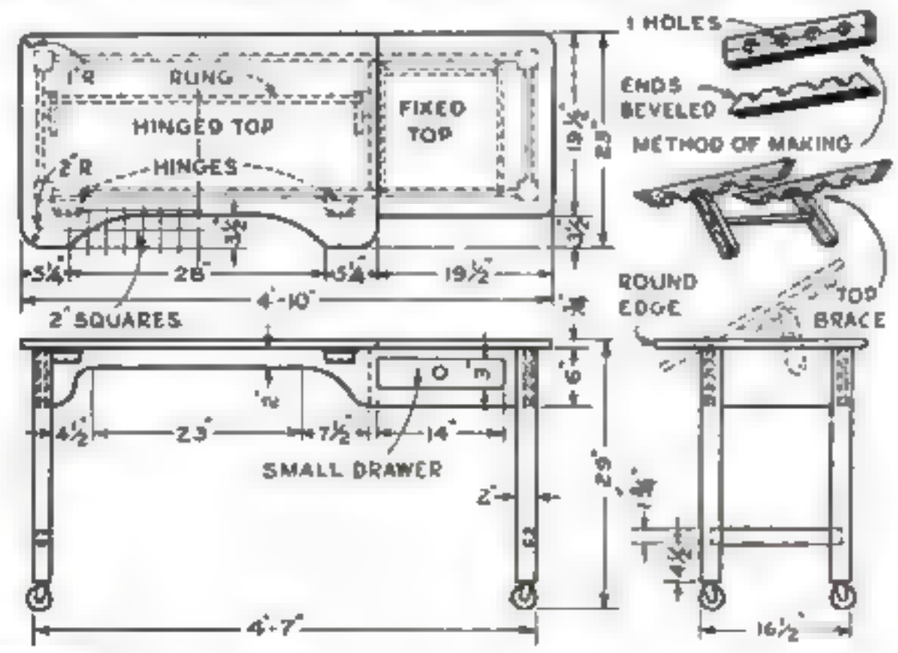
The drawings are lettered in the order in which the puzzle is taken apart, *A* and *B* being the key or locking pieces. In making the puzzle, it is better to begin with the chassis *O* and fit each piece to it as you go along. Note that most of the slots are ¼ in., ⅜ in., or ¾ in. wide.

The chassis top *N* simply rests on top of the chassis until locked in place by successive members. It is a good idea to make only such slots or notches as are necessary to fit one piece to that preceding as you go along, thus insuring tight joints. In side plates *C* and *D*, the transverse notches to represent a caterpillar tread can be cut with a three-cornered file.

Once the tank has been assembled to your satisfaction, it can be elaborated with extra guns and fittings, if you wish to make it more realistic.—K. K.

HOME WORKSHOP TABLE FOR INVALIDS

WHEN recovering from illness or injuries, many men would be much more contented if they could do a little light craftwork. This is possible if a suitable worktable is provided. The one illustrated was designed for an invalid who cannot be bolstered to a position greater than about thirty degrees and was presented to him as a Christmas gift from a high school vocational carpentry class.



The dimensions or construction may be modified as desired to suit special cases. While the table is designed to be used astride a bed, it may also be used as an ordinary table or desk. Note how the hinged top and the front rail are cut out on a curve so the table will fit the bed closely.—CHARLES M. RICE.

Longer Service from Paintbrushes

Before being put away, the bristles must be thoroughly cleaned, washed in warm water and soap, combed out, and well wrapped in old newspapers

COUNTLESS paintbrushes used in the home workshop and in keeping the home shipshape are discarded when they have given only a small part of the service of which they are capable. Occasionally an amateur painter will take a comparatively new brush back to the store and complain that it is no good. In almost every case, provided the brush was made by a reliable manufacturer, the trouble is due to abuse and negligence. Not that any home worker will purposely spoil a brush; he simply doesn't know how to look after it. Any good brush will wear well if properly used and cleaned.

If a brush has gathered a quantity of paint or other material in the "heel," soften it in a brush cleaner, benzine, gasoline, or naphtha, then wash it thoroughly with warm water and soap, comb the bristles straight with an ordinary five-cent comb or a discarded comb, and wrap it in a newspaper to absorb the moisture. Do the same every time you finish a painting job. This will, of course, be much easier to do while the paint is soft than after it has been allowed to harden in the brush.

When used from day to day on the same job, brushes may be allowed to remain in whatever material is being used, but they should then be suspended so that they are submerged only about half the length of the bristles. Under no circumstances should the ferrule be left submerged or the brush allowed to rest on the bristle ends. Bristles are very absorbent and if allowed to remain in any liquid for more than a reasonable period, they will swell. This is especially noticeable at the binding or ferrule. It is a good rule never to allow a brush to soak in water. This causes the bristles to flare and separate in bunches, making them bushy and flabby and sometimes ruining them entirely.

Don't draw a brush edgewise over the rim of a paint pot or make a practice of holding the brush edgewise for painting narrow surfaces and moldings. The brush is not intended to be used in that way, and the bristles will in time gather in bunches and cause what is called "fingering."

Brushes should not be used in fresh kalsomine or whitewash in which the lime is not completely slaked, or in other strong chemicals. The effect is the same as if the bristles had been drawn across a hot stove. The ingredients in cheap paints may also injure the bristles. Curling at the ends is an indication of this trouble. Bristles are also deformed by the habit of poking the brush into places that are difficult to paint and by allowing a brush to rest on the bristles.

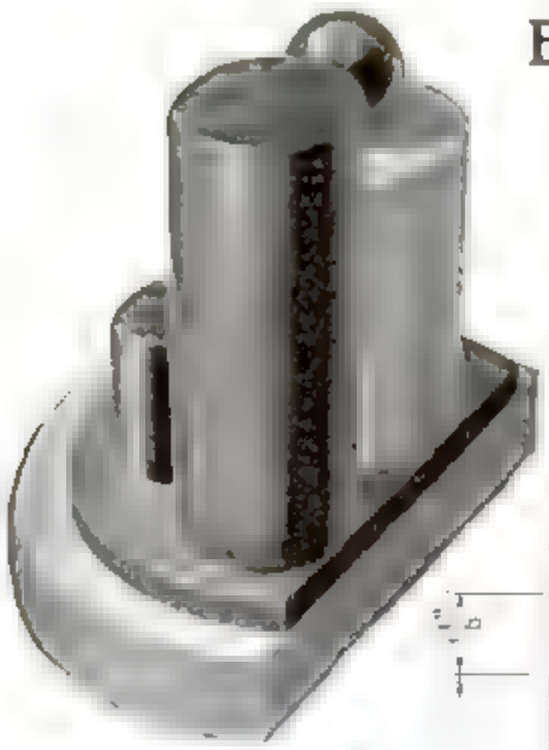
A surface that has not been painted before, or a rough surface, will wear bristles down faster than a smooth surface. If, however, a brush wears unevenly in such a way as to give it a misshapen look, the fault lies in the method of brushing. It has been used habitually at too great an angle, edgewise, or on surfaces narrower than the brush. A general flaring of the bristles is, in the majority of cases, the result of allowing paint to work up into the heel of the brush close to the ferrule and dry there.

Before being used, a new brush should be shaken to remove any loose bristles that were not caught in the setting. After they are removed, the only bristles that will come out of a good brush are those which are broken off.

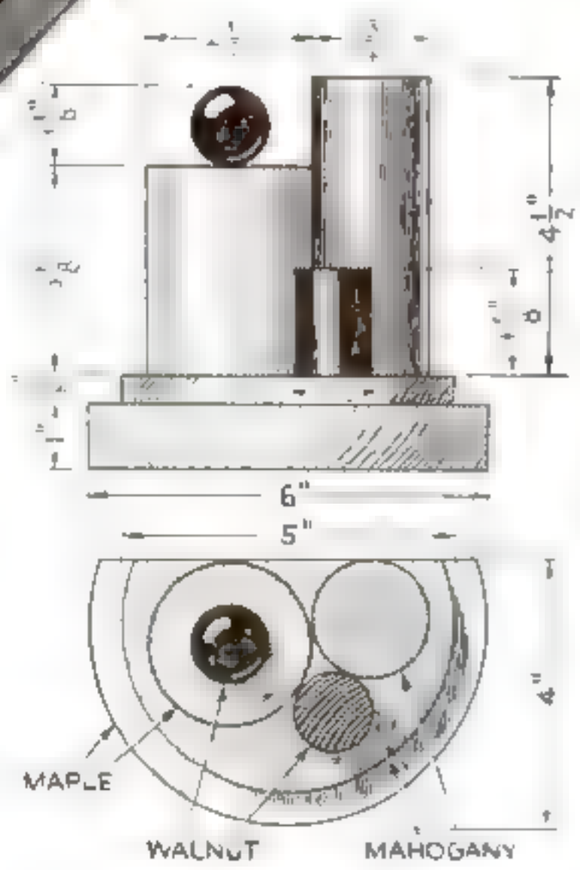
These difficulties are mentioned so that you will recognize their cause, but they are all quite unnecessary and can be avoided.—AARON LINZER.

BOOK ENDS TURNED FROM SCRAPS OF HARDWOOD

IF YOU have a lathe and a few scraps of different hardwoods, you can quickly turn out attractive modern book ends like the one illustrated at the left. They are sufficiently heavy to hold the books in place without toppling over. Only six pieces required for each



Each of these modern-looking book ends is turned from six scraps of wood. Maple, walnut, and mahogany were used in this case, but any combination of contrasting hardwoods will serve quite satisfactorily



The two disks which, when combined, form the base, are first sawed to size, then smoothed on the faceplate of the lathe. A segment is sawed off each of these disks as shown. In turning the ball, a short dowel is left to fit a hole in the top of the largest cylinder.

To assemble the parts a countersunk screw may be passed up from the bottom into each of the cylinders, or a ½-in. hole may be drilled to receive a dowel. The wood is given a natural finish and left in a high polish to conform to the modern style. A piece of brown or gold felt is glued to the bottom.

Varieties of wood other than those indicated in the drawing may, of course, be used, but natural wood in pleasing color contrasts is preferable to stain or dye.—JOHN PATTERSON.

POKER CHIPS SERVE AS TAGS FOR SHOP USE

LEGIBLE, inexpensive, and durable tags are often required about a shop, especially if much repair work is done and numerous jobs have to be marked for identification while special parts are being made. Better than ordinary tags for this purpose are cheap composition playing-card chips. They are proof against oil and water, can easily be written on, and can be cleaned without difficulty. Simply drill a hole through each chip near the edge and loop a rubber band through it as shown above.

In one radio shop where a great many household devices are repaired, a red chip is used to indicate work that is unfinished and a white one for jobs that are completed.—FRANK W. BENTLEY, JR.

Colorful Modern Desk Set

MADE FROM A SINGLE SHEET OF SYNTHETIC RESIN

By ALBERT Q. MAISEL

HERE'S a modern desk set that any amateur craftsman can make with the simplest hand and motor-driven tools, yet it compares favorably in quality and beauty with expensive commercial products. The material used is one of the new cast-resin plastics, which can be obtained in a great variety of colors and mottles. That used in the original desk set closely resembles marble.

The design is remarkable in that only a single sheet or block of the cast-resin composition is required—a piece 1 in. thick by 6 by 16 in. In addition a sheet of stiff cardboard 18 by 24 in. is needed for backing the desk blotter, together with a blotter of equal size, a small piece of blotter of the same color for use on the rocker, some strips of felt, and a small quantity of cast-resin cement.

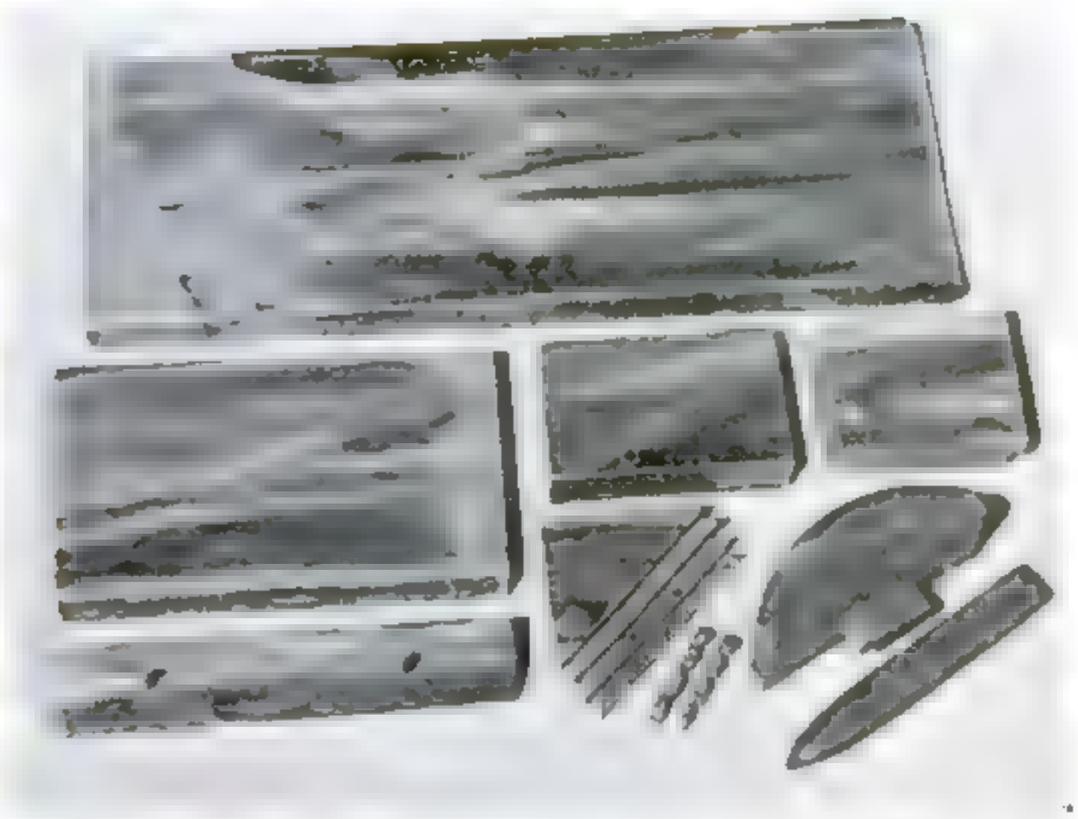
First cut the large sheet into two equal sections, each 6 by 8 in. Then make a transverse cut on one of the halves to obtain one piece measuring 8 by 4¾ in. for the base of the pen stand, and another 8 by 1¼ in. to form the upper part of the same stand. These cuts are most quickly and accurately made on a circular saw, using a 5-in. metal-cutting blade, but they may be made by hand with a hack saw or on a band saw. In the latter case, great care must be exercised to keep the saw blade from weaving out of line.

All rough edges left by the saw should be sanded smooth and true. The base of the pen stand should be sanded to a radius of about ¼ in. on its forward edge. If a flat sanding disk is used on a lathe, this operation can be quickly accomplished. If no sander is available, cut a sanding block with a concavity of the desired radius out of wood, and use this block with a medium fine sandpaper, finishing off with a very fine grade of paper.

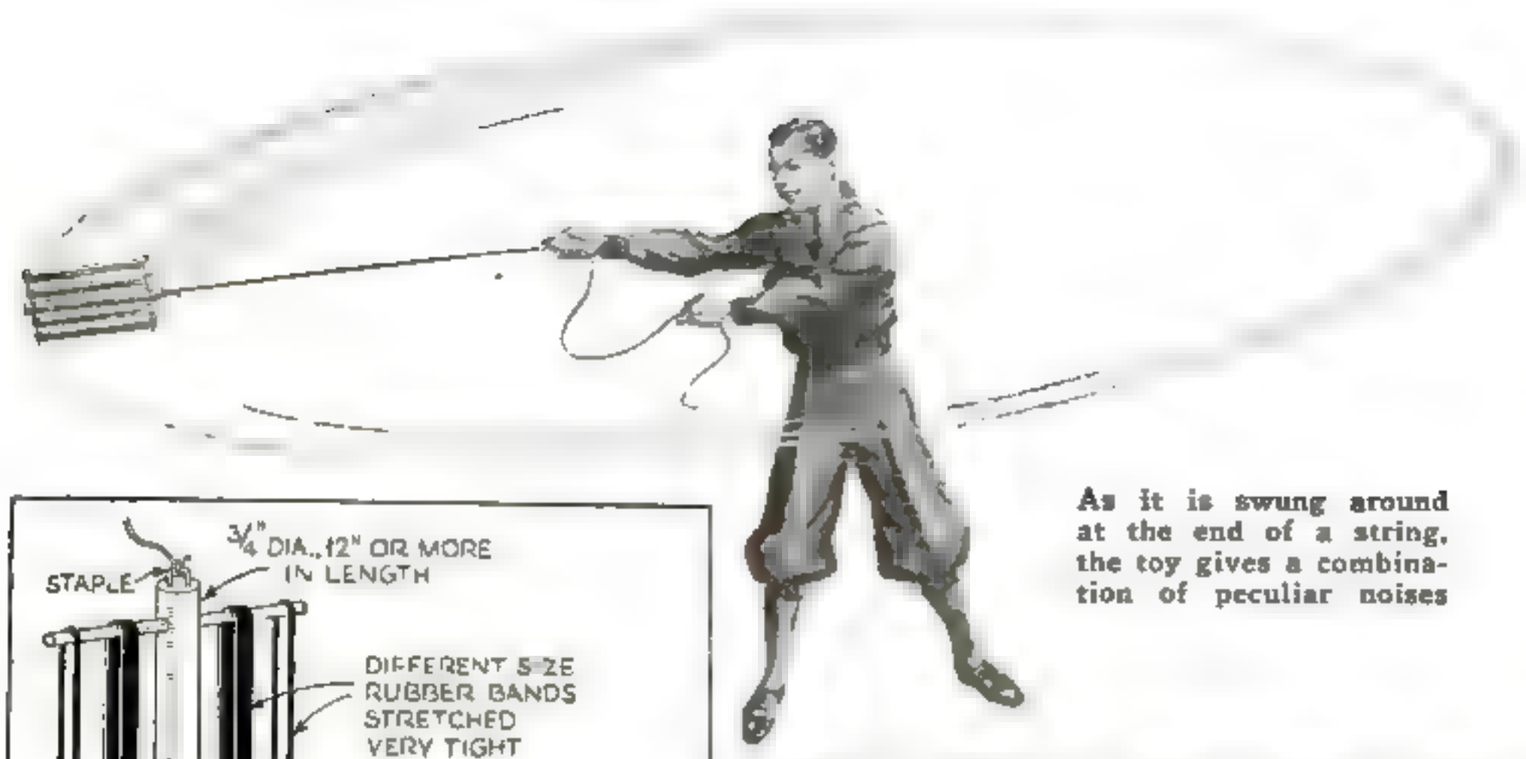
(*Continued on page 106*)

There are five pieces in the complete set, all of cast resin

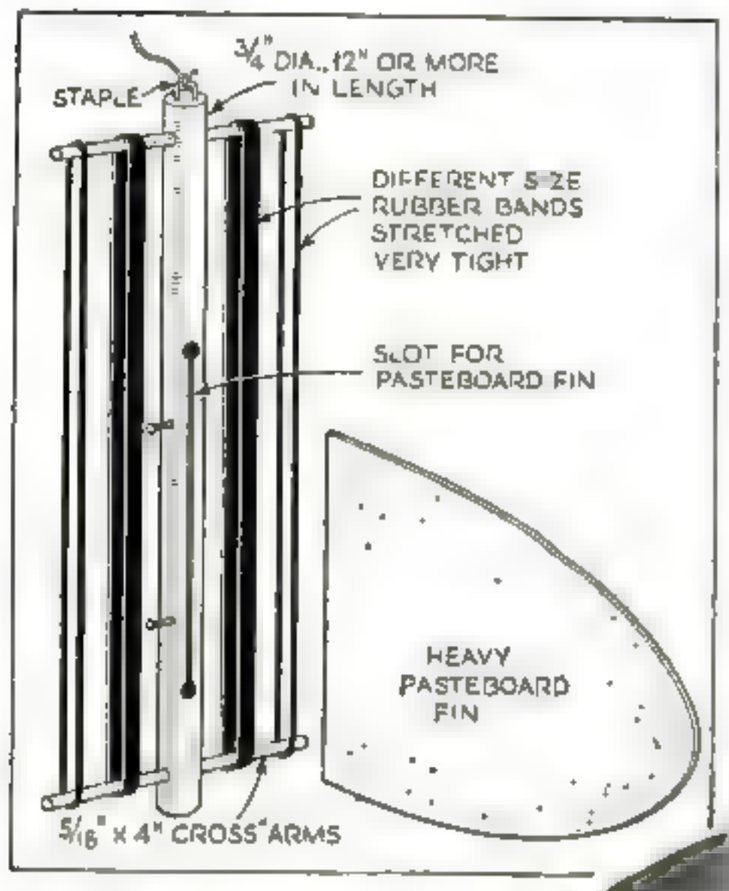
The rocker blotter is left clamped for twelve hours for the cement to harden. *In oval:* How the curved bottom is sanded



The original uncut block (at top) and the various individual pieces laid approximately in the positions they occupied before being cut



As it is swung around at the end of a string, the toy gives a combination of peculiar noises



The whirling harp consists of a round stick with two crosspieces over which rubber bands may be stretched. The stick is slotted to receive a thick pasteboard fin to steer the device

NEW WHIRLING-HARP TOY GIVES WEIRD NOISES

When swung around the head at the end of a cord, the whirling-harp toy illustrated above and at the left will produce a weird combination of sounds that resembles angry hornets, zooming airplanes, racing autos, and whining puppies.

This novelty consists simply of a heavy round backbone with a thick pasteboard fin and two cross arms upon which rubber bands are tightly stretched. Varying the tension of the bands gives different sound effects. It may be necessary to shorten the bands by tying knots in the rubber if they are not tight enough at first.—H. S.

Old Bill SAYS:

DON'T use shopmade mixtures for lapping purposes, but specially prepared compounds. Cast-iron laps cut the fastest, but whitewood laps give the best finish.

• • •

Save discarded high-speed steel end mills and cut off the body to the neck. When ground to the required angle, they make excellent centers to be used with collets.

• • •

Don't confuse the terms "expansion" and "adjustable" when speaking of reamers. Expansion reamers are of solid construction and fitted with a tapered screw on the end, while adjustable reamers have removable blades.

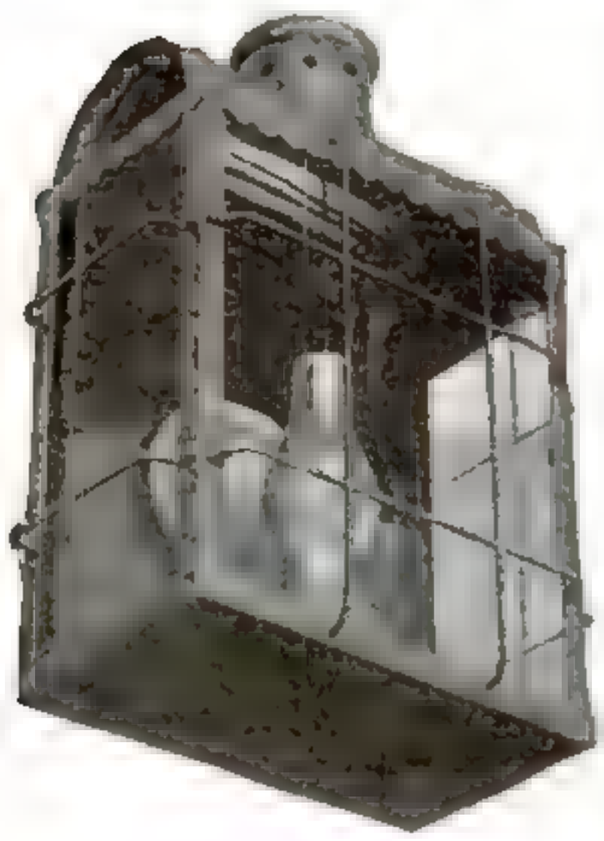
• • •

Centrifugal force is something to bear in mind when using grinding wheels as it increases as the square of the velocity of the wheels. Remember this and stand aside before setting any grinding wheel into motion. Amateur mechanics in the home workshop should be equally cautious, even with their comparatively slow machines

• • •

The best way to make a line reamer is to fit the blades with the least pressure and solder them to the body. This prevents jamming the assembly when resetting.

Decorative Porch Lamp of Marine Design Is Made of Brass



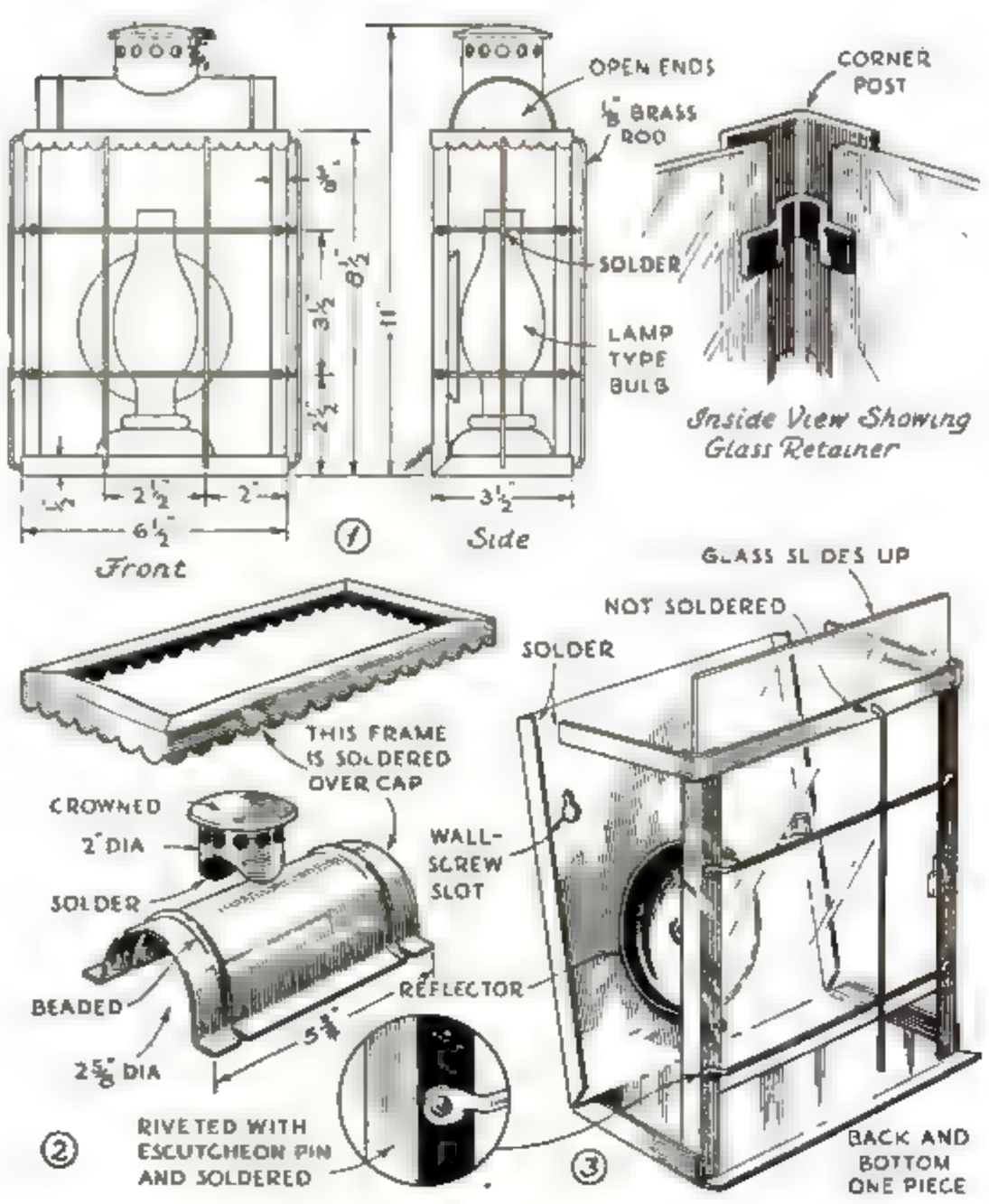
This attractive marine-type lamp, made of sheet brass and light brass rod, requires little experience in sheet-metal work. With a kerosene lamp type of electric bulb, if one can be obtained, and a suitable reflector, it is particularly effective and gives ample light.

Note that the bottom and back are made of one piece of sheet brass cut as shown in Fig. 3. The edges are bent over and soldered.

The front corner pieces are simply ¾-in. strips of brass bent down the middle at right angles to form angle posts. A flat strip is soldered around the top, making the complete frame. Before the front corner pieces are set in, however, small retaining strips should be soldered inside.

The brass wire rods, which are about ⅛ in. in diameter, are flattened, drilled at the ends, riveted with cut-off brass escutcheon pins, and soldered. These are for the horizontal bars in front of the glass. The vertical bars are soldered only to the horizontal ones.

For the cap, make a rectangular frame as illustrated in Fig. 2. This fits over, and is soldered to, a semicylindrical piece with open ends. A small turret is soldered on top of this. This top unit should be made a neat fit over the lamp frame, and, of course, it must be removable so the glass panes can be renewed in case of breakage.—Dick Hixon.



Front and side views and sketches showing method of construction. A lamp of this type is particularly effective if hung against a white wall

A Quick, Accurate Way to Make

PICTURE FRAMES

By GUY A. RAFUSE

Sighting along the head of a combination square to set the guide block at 45 degrees to the disk

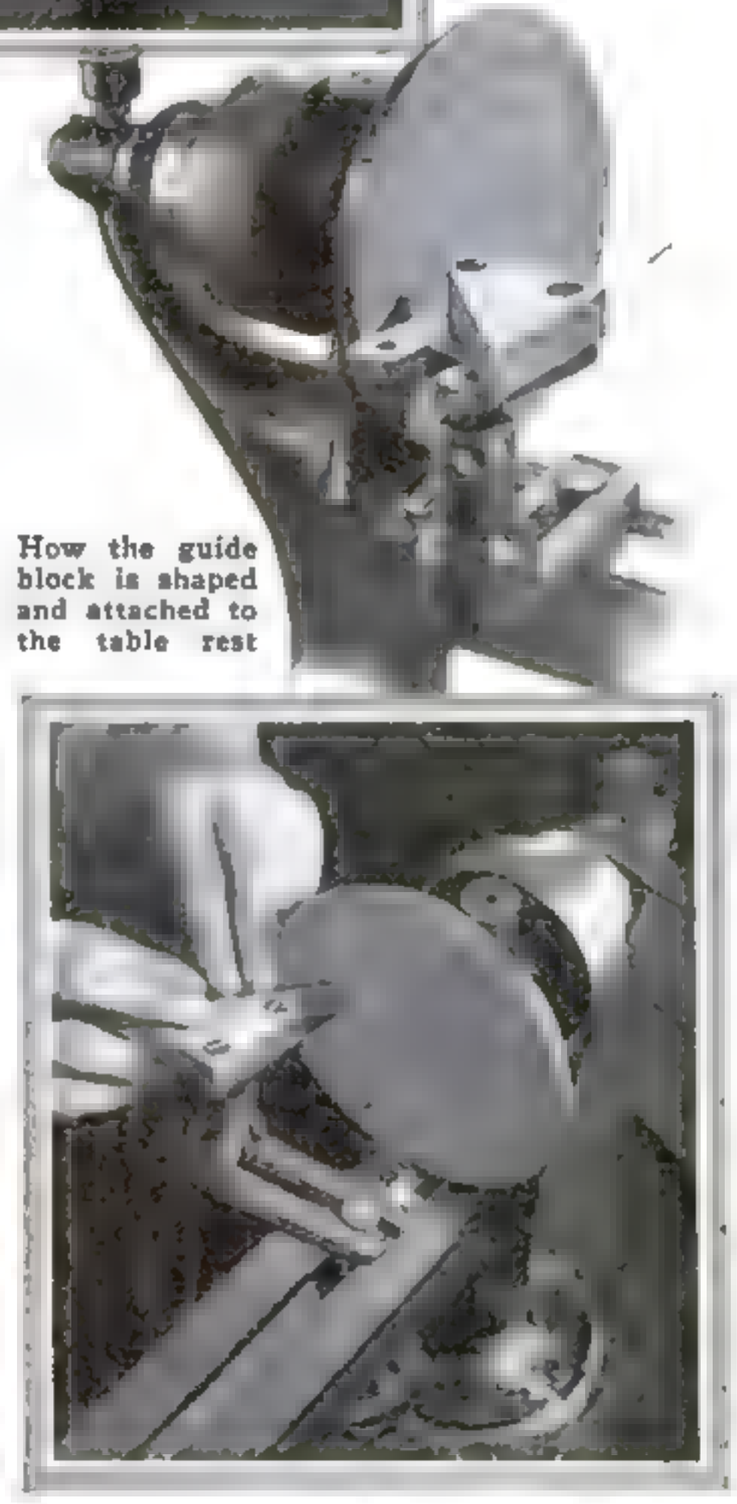
ONE of the many ways in which the home workshop may add to the income of its owner is the making of picture frames. By using the method outlined below, which involves the purchase of no extra equipment, the amateur woodworker can turn out a frame equal to the factory-made product and better than that usually offered by local picture framers.

There are three things that distinguish a well-made picture frame. First, the individual sides are accurately measured so that the frame will be a perfect rectangle when assembled. Second, the ends of the molding are cut at exactly 45 deg. so that the joints will show no V-shaped slots, the closing of which would tend to draw the frame out of shape. The cut is also perpendicular to the back of the molding, making the finished frame lie flat against the glass, and the surface of the cut is as smooth as possible to insure a close fit. Third, the corners are carefully joined and show no projecting edges along either end or the front of the joint.

The first requirement should give no trouble to the amateur woodworker, who is accustomed to making careful measurements, but it might be well to remind him that all measurements are made along the inside back edge of the molding. It is with the second and third conditions that this article is chiefly concerned.

The molding is first measured, then sawed slightly longer than the measured length and at an angle of about 45 deg. This may be done conveniently with a jig saw, but if one is not available any other fine-cutting saw may be used. The next step is to sand each end of the molding down to the mark showing the correct length, and at the same time give the end an accurate 45-deg. face. This is done on the lathe with the aid of a table rest fitted with a guide block, which is merely a small piece of hardwood cut to fit the table rest as shown in the illustrations.

The 45-deg. face of the guide block must be made at a perfect right angle to the surface of the table rest, which is best done by sanding before it is fastened to the table rest. The final adjustment is made by using as a standard any accurate 45-deg. angle, such as the head of a combination try- and miter-square. By holding one side against the face of the guide block and



How the guide block is shaped and attached to the table rest

With the aid of the guide block, the end of the molding is sanded to give a perfect joint

sighting along the other side and the face of the sanding disk, the guide block can be set very accurately and locked in place with a set screw on the table rest.

When this is done, it is a simple matter to hold the molding on the table rest against the face of the guide block and sand the end down to the marked length more accurately and with a finer finished surface than can be done with a saw.

One trouble that must be guarded against is the damaging of the finish on the molding near the edge of the cut. Some types of finish are quite sensitive to heat, and if overheated by sanding on a worn disk will show a crimped effect along the edge of the cut.

When working with dark molding, it is wise to blacken or stain the surface of the cut before assembling the frame, since even a very small fraction of an inch of bare wood exposed at the joint would be quite conspicuous. Pressing the end of the molding on a well-inked stamp pad will do it quickly and satisfactorily.

The final operation of assembling requires an ordinary bench vise, the jaws of which are lined with cardboard to prevent marring the finish of the molding. The corner to be nailed is placed between the jaws of the vise, the two adjacent sides set so as to form a joint as nearly perfect as possible, and the vise tightened to hold them firmly in place. A small nail driven through each end of each side of the frame into the adjacent side will hold the frame together quite satisfactorily, but a stronger frame can be made by gluing the joints in addition to nailing them.

The sanding disk previously mentioned may be a commercially made one or, as in the illustrations, homemade. In either case it will be useful for many other purposes in addition to that mentioned here. The guide block, since it can be set at any desired angle, may also be used for other purposes.

Besides making frames for himself and his friends, the amateur woodworker may be able to make arrangements with a local department or novelty store to sell his frames or take orders for complete framing jobs.

An ordinary bench vise, its jaws lined with cardboard, holds the frame while being nailed

Making the MASTS, YARDS, and other SPARS for our

GREAT REPUBLIC MODEL

By Captain
E. Armitage McCann

Correctly proportioned spars are the first requirement in rigging the model successfully

OUR new model of the *Great Republic*—by far the finest and largest of all our clipper-ship models—is now practically complete in respect to the hull and deck fittings. Those who wish to build this magnificent model but have missed the two preceding installments, should look them up (P.S.M., Dec. '35, p. 59, and Jan. '36 p. 86).

The *Great Republic* as originally built was, I believe, more heavily rigged than any other merchant vessel. Her spars were large, even for her size; her main yard was 120 ft. long, as compared with the *Flying Cloud's* 82 ft. or the *Roanoke's* 92 ft. Her foretruck was 206 ft. from the deck; the *Roanoke's*, 180. The *Roanoke*, built in 1892, was the largest American vessel, but not an extreme clipper.

Although a fast ship, the *Great Republic* never got a fair trial with her full rig, because when rebuilt after the fire her rig was reduced about 15 percent. Her best records were 19 knots for 19 hours and New York to San Francisco in 92 days, including three days calm off the latter port.

The initiated will at once notice several unusual features on the rigging plan. As first rigged, she was one of the few ships that had Forbes' double topsails, with which the lower topsail yard hoisted on the head of the lowermast, requiring the topmast to be fidded abaft.

She had cap stays, three topmast and two topgallant backstays; otherwise she was much like other clipper ships. She was one of the first vessels to be rigged as a four-masted bark. What is now called the jigger mast was then called the spanker mast or sometimes the McKay mast.

First we must make a set of spars from birch dowel sticks or other straight-grained wood. The correct lengths and diameters are shown.

All of the spars will need some preparation before being shipped. These fittings are indicated by letters following the numbers of the spars on the tabulation at the end of the article marked "Key to Rigging Plans."

The bowsprit is round with a flattened top and tapers slightly. As it is a built-up spar (44 in. diameter), it requires hoops. I made all the hoops by gluing on two turns of 1/16-in. wide strips of writing paper. A cleat *(a)* is nailed on the 'sprit to hold the jib-boom end. The cap *(b)* is cut to lie at a right angle to the bowsprit; it has a square hole for the squared end of the 'sprit and above, a round hole to fit the jib boom, with its height so that the jib boom will parallel the 'sprit. Under this is an eyebolt for the dolphin striker; one on either side for the spreaders, and others above for the handropes. The caps can be made of 3/32-in. boxwood, celluloid, or fiber board. All eyebolts I make of ½-in. pins bent to shape with round-nosed pliers that have one point filed quite small. Heavier bolts are made in the same way from larger pins.

Butting up to the cap are the bees *(c)*, which are merely wooden cleats with notches cut out for the stays to reeve through. All this is white. Underneath, two hearts are needed for the bobstay lanyards. These hearts I make of boxwood, triangular on the outside, with a groove and one large hole. I seize them on with wire passed right through the 'sprit. Hearts are similarly fastened on each side for the bowsprit shrouds *(e)*. There should also be a little cleat to retain the gammoning *(f)*.

This unusual photograph shows three of the yards on Captain McCann's model, rigged as on a real ship

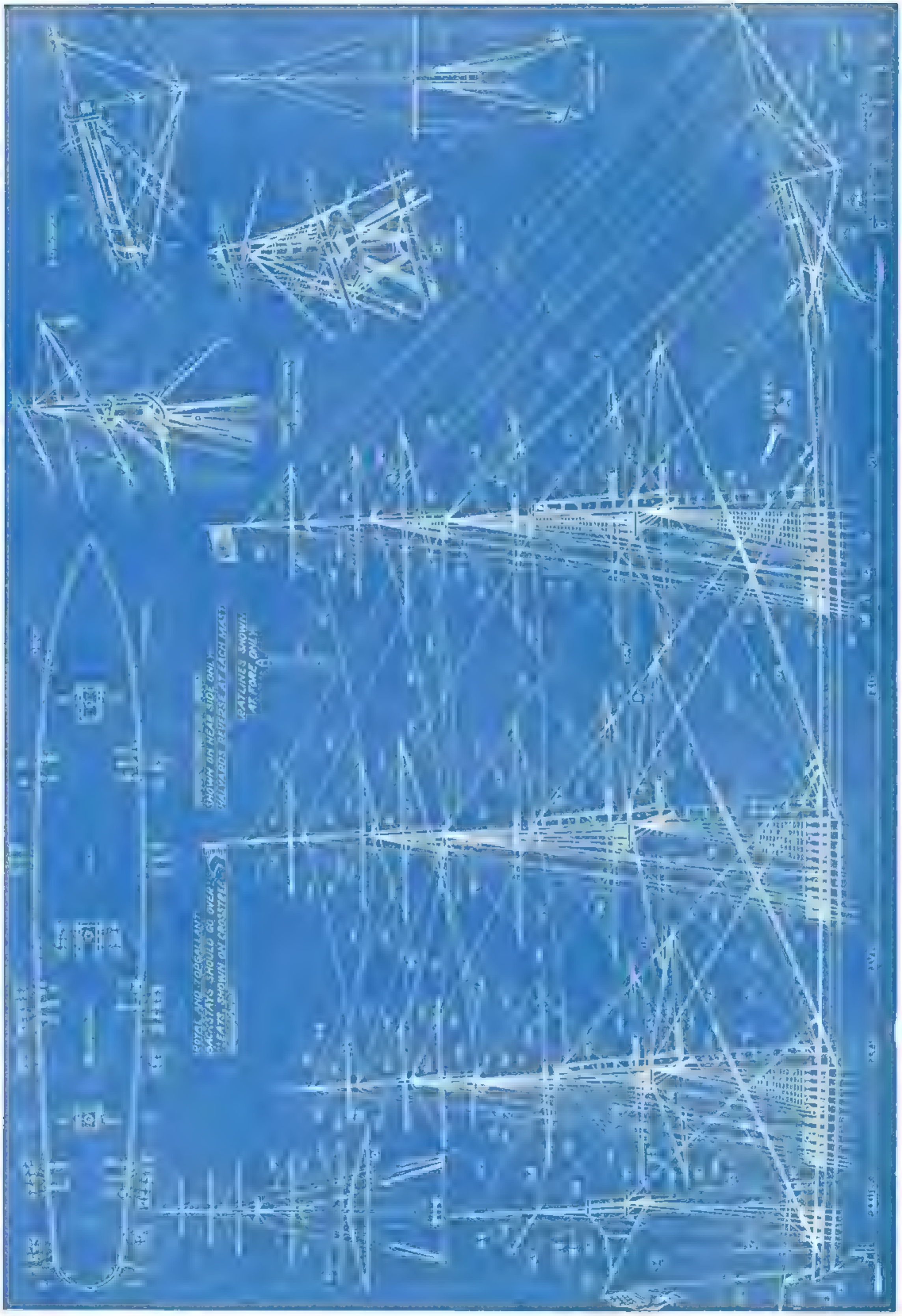
The bobstays *(d)* are chain nearly as large as the cables. They are wire-seized to the straps on the stem and have hearts in the upper ends, with lanyards which draw them tight. The bowsprit shrouds are of the same size chain, similarly set up from bolts nearly under the catheads.

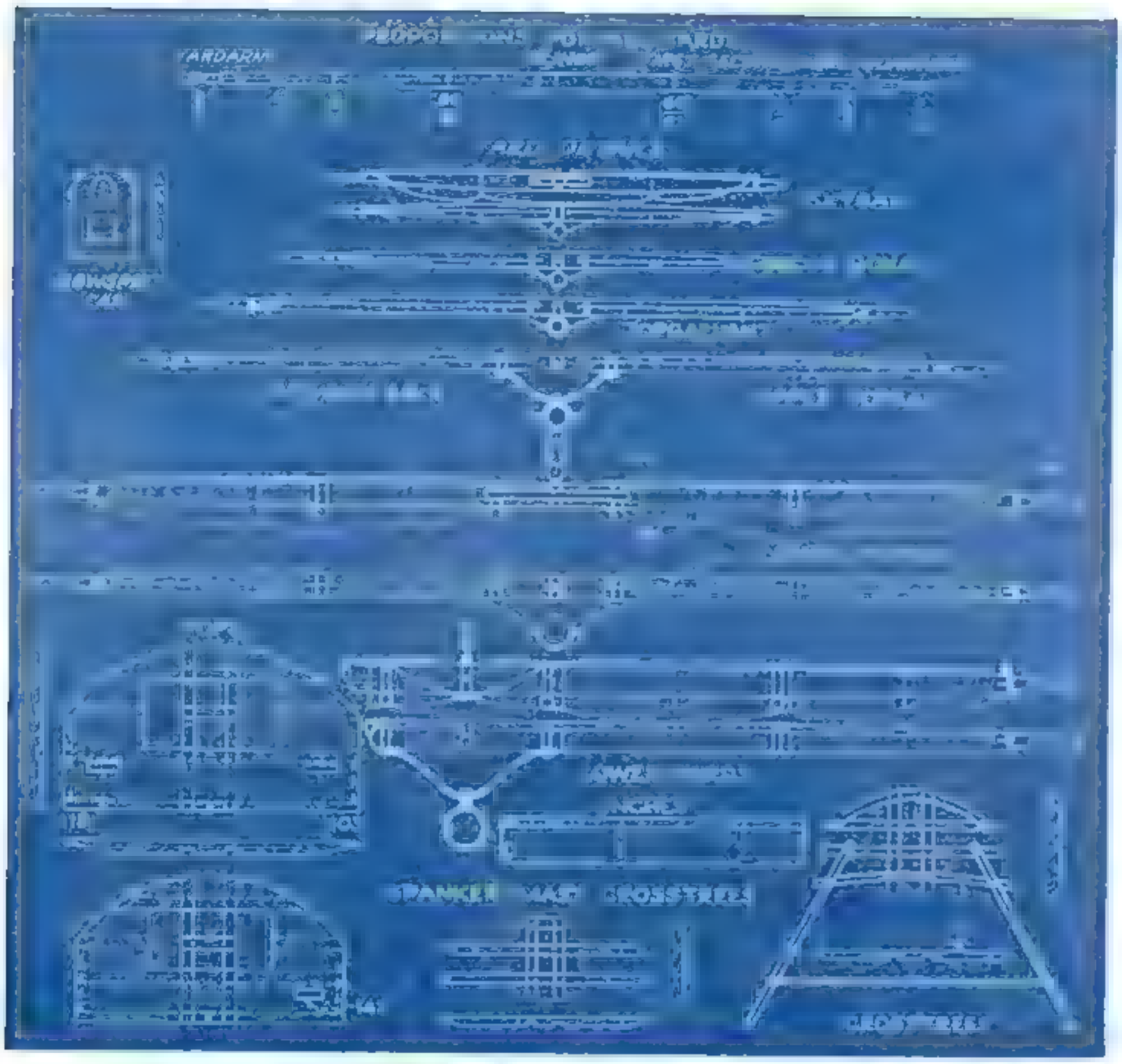
A lowermast has bands as shown *(h)*. On the fore side is the paunch *(i)*; this is a wooden batten to take the chafe of the sail, so a piece of cardboard, cut to fit over the bands and glued on, will serve to represent it. The part marked *j* is a belaying-pin band; I made this by forming eyes in small pins, putting part of other pins through the eyes, and touching with solder.

The futtock-shroud band *(k)* has an eye on either side—eyes of wire passed right through the mast and twisted together. *(Text continued on page 74)*

. . . . A Game for MODEL MAKERS

HOW many parts of a ship's rigging can you identify by name? Here's a chance to find out by making a game of it. Just see how many of the numbered parts on the facing page you can name correctly, and compare your list with that on page 95. It doesn't matter in the least whether you are actually building a model of the *Great Republic*, because the same designations are used on all clipper ships and are standard nautical terms.


BAYLINES SHOWN
AS FOUND ON
SHOWN ON NEXT SIDE ONLY
SHOWN ON CROSSFILE



Standard proportions and details of the various yards, tops, crosstrees, and bowsprit cap

The cheeks *(z)* are pieces of wood cut to shape and nailed fore-and-aft to the mast, which is there slightly flattened. Note that they extend abaft the mast. The truss band *(m)* is like the others but with a hole through it to take a No. 20 escutcheon pin.

The tops *(o)* are shown in detail. They consist of the trestletrees into which the crosstrees are half-lapped athwart; on this goes a flat floor piece, 1/16 in. or less thick, with the lubber hole cut out of the middle and a smaller hole for the hauling part of the topsail halyards to pass through. On either edge of the tops are four slots for the futtock-shroud straps. The tops should fit the lowermasts tightly and rest on the cheeks to lie *horizontal*. Nail through the trestletrees to the mast.

The futtock shrouds *(p)* are made of wire, with ⅛-in. deadeyes turned in the ends. They then pass through the top and have their lower ends turned up and soldered to the eyes on the mast.

The bands above the top would have to be flush with the mast, so I indicated them with black paint between two knife cuts.

The caps *(q)* are as for the bowsprit, but be careful that the masts here, as elsewhere, are parallel. They need strong eyebolts on either side for the cap stays and backstays. I drove these well into the lowermast heads.

Underneath the cap is a cleat on one side *(n)* and an eyebolt on the other for the standing and hauling parts of the topsail-yard chain ties. The cleat will be to starboard at the fore and mizzen masts and to port at the main. Halyards reverse sides as they go higher and also reverse at each mast.

These masts may now be stepped. Where they meet the deck, there should be mast coats to keep the water out. One can represent these with wooden or fiber rings or build them with plastic material. If the hull is hollow, put two-pointed nails in the heels to steady them in position. One might now rig these masts, but let us prepare all the spars, so that they will be ready to use.

The topmasts are simple. They are very slightly tapered from the cap to the trestletrees and from there up are square, with a slightly smaller square for the cap to fit on. Athwart, near the end, is a hole to take a stiff wire, representing the fid, which lies on the crosstrees. At a point ¼ in. above this is a hole and slot for the mast rope, to hoist the mast with; it goes aslant from the starboard foreside to the port afterside. There is a hole fore-and-aft under the crosstrees large enough to take the upper topsail halyard tie. The crosstrees and cap are shown in detail. The outriggers must be firmly fixed to the crosstrees because they are to spread the royal and skysail backstays, but make them as light as possible.

The topgallant, royal, and skysail masts are each one spar which is shipped to the foreside of the topmast. Each section is of even thickness, dipping to leave a shoulder at the mastheads, only the pole being tapered. They have holes similar to the topmast. The trucks are round balls drilled halfway through to take the ends of the poles. They should be gilded. It is best to leave them off until the flags are ready.

The jib boom tapers slightly from the cap, most of the thickness being reduced at the shoulders or stops. Vertical holes must be drilled for the stays to pass through. It is white to the cap, at the stops and the end; the rest is natural spar color.

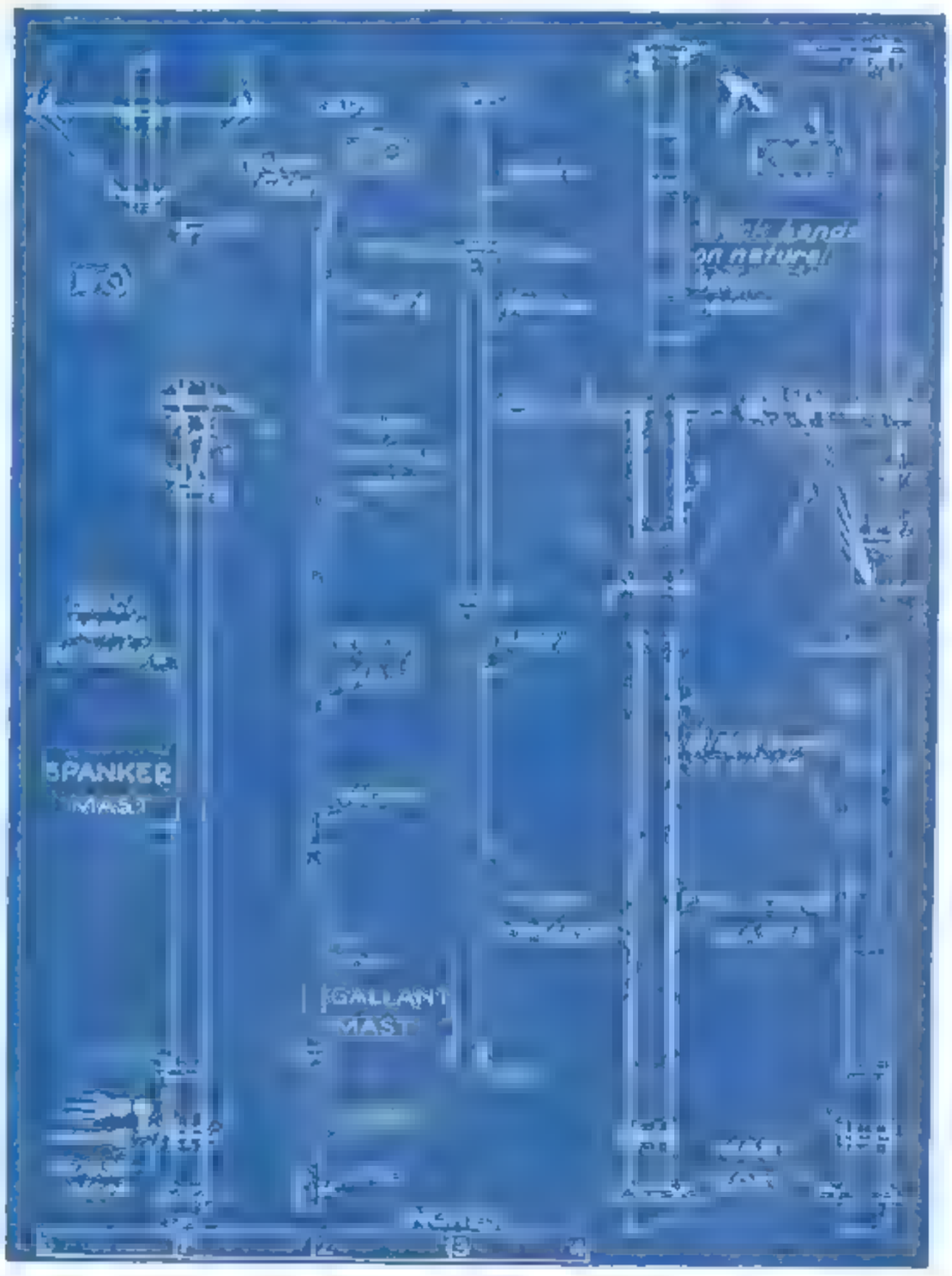
The spanker mast has a belaying pin band and bands *(B)* for the boom and gaff goosenecks. These latter bands are of thin metal with eyes abaft. The gooseneck I made by splitting a piece of brass rod, drilling the lugs thus formed, and filing the other end to a long thin point, to go into the spar. The upright member is a bent pin, with a bolt (pin) set through both and soldered. For the futtock shrouds there are eyes on the upper gooseneck band. I then made an eye in a piece of wire, passed it through the crosstree, through the eye on the mast, up through the other crosstree, and there formed another eye.

The topmast and topgallant mast, in one, are made like the other topgallant masts, with sheave holes for the gaff topsail and gaff topgallant halyards.

The spanker boom and gaffs taper from a point one third from the mast to the ends. Under the boom is a U-shaped runner for the boom sheet blocks.

The upper gaff is fastened in position with a wire through the end and taken around the mast between the stay and backstays. Gaffs and boom are natural wood with white ends.

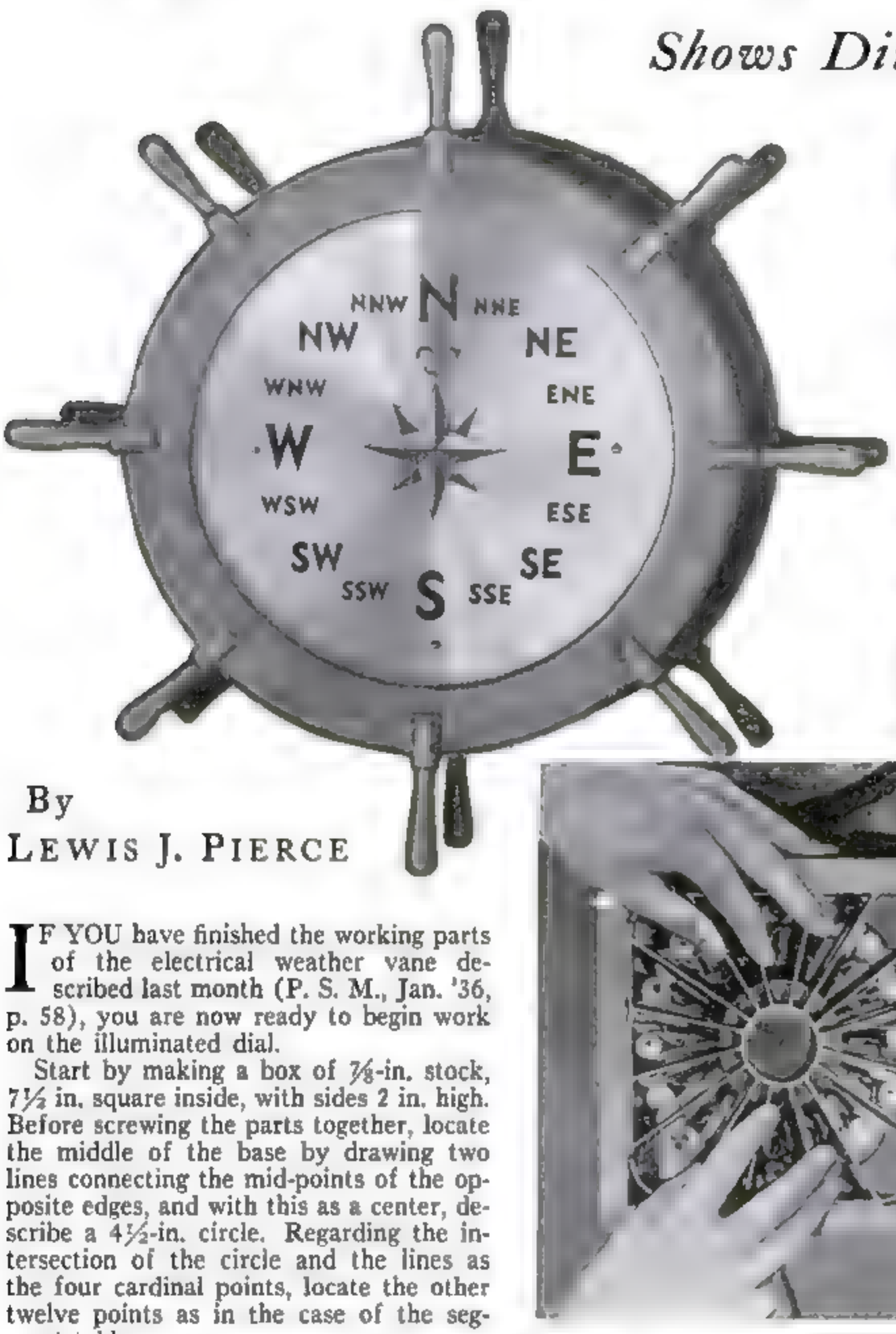
The martingale boom, frequently *(Continued on page 94)*.

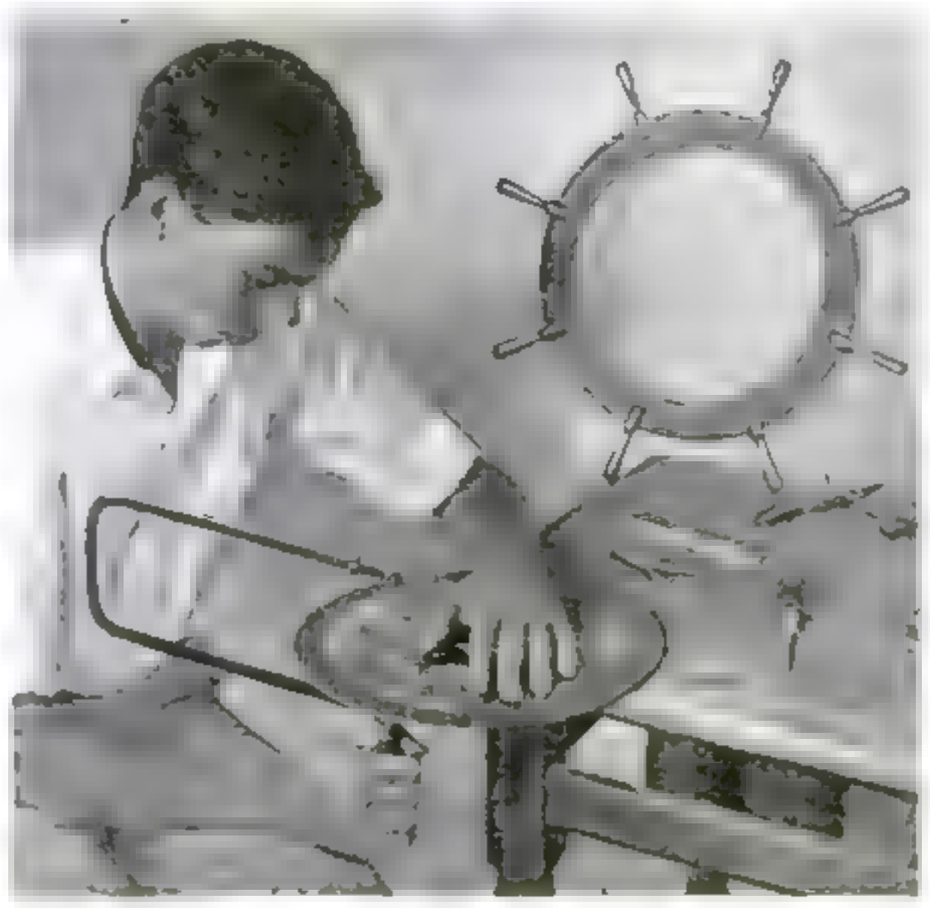


How the masts are constructed and painted. The actual diameters and lengths of each mast and yard are tabulated near the end of the article

Illuminated Indoor Dial

Shows Direction of Weather Vane





The letters are cut in the brass dial with a deep scroll-saw frame and jeweler's saw blade

By
LEWIS J. PIERCE

IF YOU have finished the working parts of the electrical weather vane described last month (P. S. M., Jan. '36, p. 58), you are now ready to begin work on the illuminated dial.

Start by making a box of 7/8-in. stock, 7½ in. square inside, with sides 2 in. high. Before screwing the parts together, locate the middle of the base by drawing two lines connecting the mid-points of the opposite edges, and with this as a center, describe a 4½-in. circle. Regarding the intersection of the circle and the lines as the four cardinal points, locate the other twelve points as in the case of the segment table.

The sockets for the light bulbs are spring-type wooden clothespins. These are fastened to the base of the box with screws through their springs at the intersection of the circle and the sixteen compass lines. Sixteen 6 to 8-volt bulbs are inserted in the clothespin sockets, and sixteen contact arms are made of brass as shown and screwed in the box so their ends touch the base of the lamps.

One wire from the current source goes to a switch near the dial, then up through the house directly to the control box. The other lead-in wire goes through a hole in the bottom edge of the box as it hangs on the wall and makes a complete circuit, connecting with each of the sixteen contact arms.

The sixteen wires of the cable are lead in through a hole in the middle of the base of the box; they are then fanned out and an inch of insulation is scraped off the end of each. Next is the task of connecting the right wires with the bulbs, which can best be done with an assistant. Knowing the position the control box will be placed in and the direction of north, you can easily determine the north segment of the segment table. Have your assistant swing the vane around until the switch lies on the north segment, and then touch the wires in turn, one after the other, to the north bulb of the dial. When it lights, slip the end of the wire into the socket alongside the base of the bulb. In a similar manner connect all the remaining wires and remount the vane.

Each light is separated from the adjacent one by partitions cut from sheet metal 13/16 in. wide. Eight of them are 2⅞ in. long, and the rest 3½ in. long. After inserting them in saw cuts made in a round wooden block as illustrated, solder a wire around the top of the outer edges flush with the surface of the box, to hold them evenly spaced. Glue velvet strips as needed to top and outer edges of the partitions to make light-tight joints with the box and dial face. Place this assembly in the box and screw it to the back, giving each light an equal compartment.

The face of the dial, which represents a ship's wheel, is *(Continued on page 101)*

The partitions are inserted as a unit. To insure even spacing, the inner ends are soldered to a tin band, the outer ends to a wire

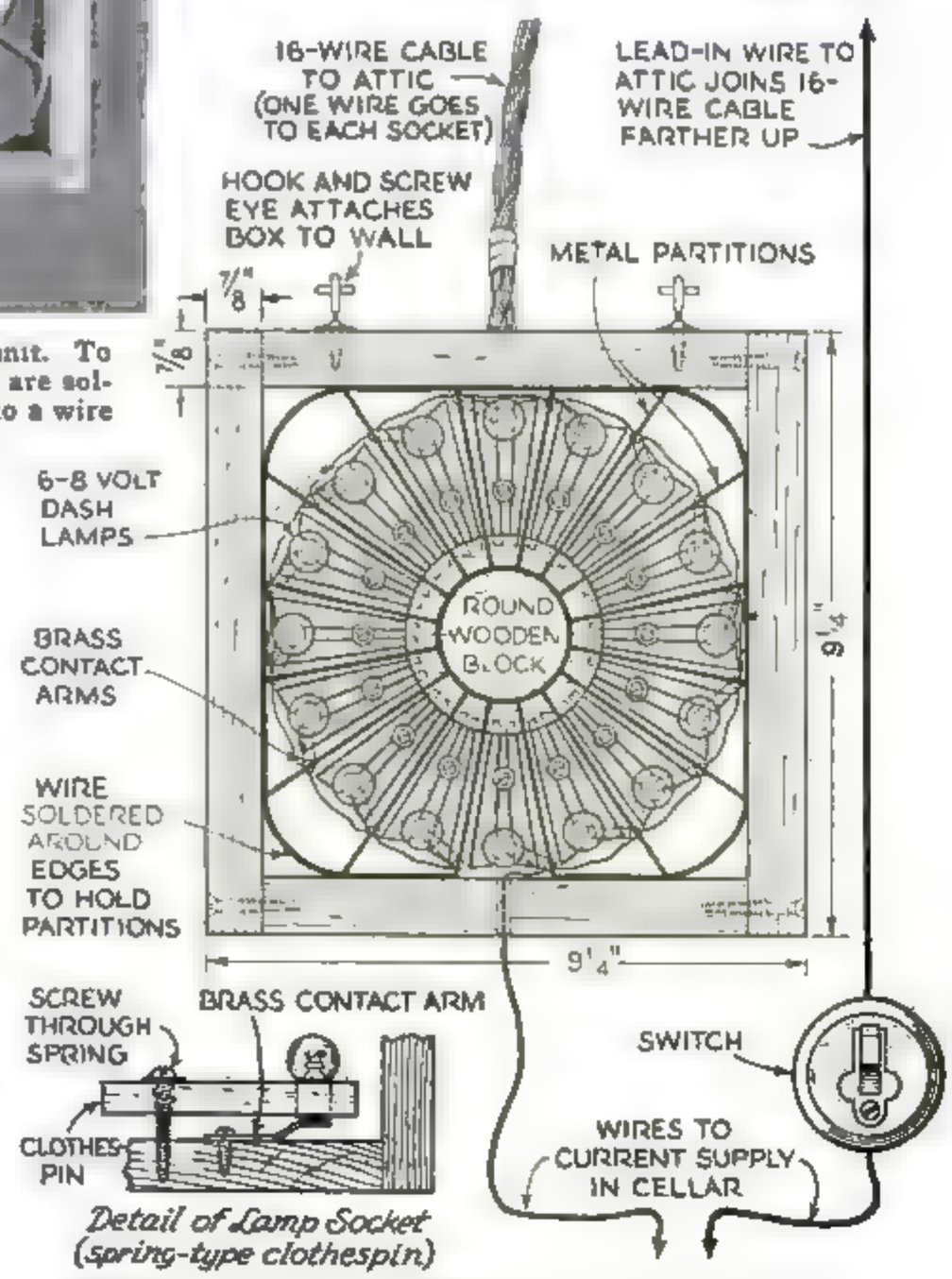


Diagram showing the partitioned box with its sixteen lamps mounted in sockets made from spring clothespins

Cabinets and Tool Racks Keep Shop in Order

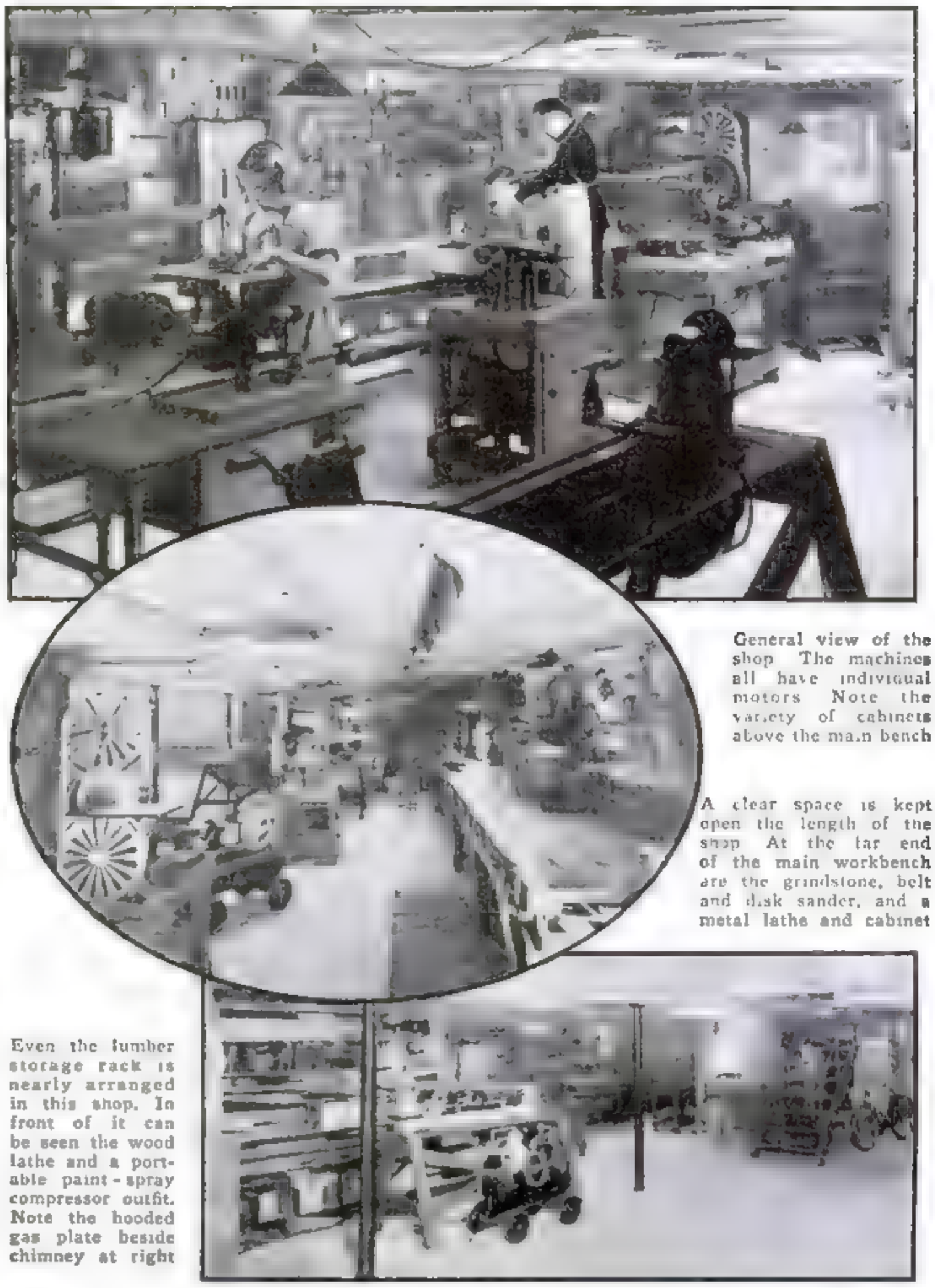
THE unusually well-arranged home workshop illustrated is that of F. L. Sahlmann, of Erie, Pa. It is the outgrowth of his boyhood ambition to have a shop and represents the accumulation of tools and machines over a period of approximately ten years. Much of shop furniture and some of the accessories have been made by the owner.

When the photographs were taken, the belt and disk sander and the motor-driven grindstone were not available, but they are located as shown in the diagram. The fact that Mr. Sahlmann's house has automatic oil heat makes it possible to keep the shop in a spick-and-span condition; furthermore, the use of individual motor drive, in which he is a firm believer, makes it practical to take a machine to the work, if necessary, or to move it from one location to another.

Drawers, cabinets, and various containers are provided for practically all the tools. It is an ironclad rule to put everything away and clean up the machines and floor when work is finished in the evening.

Of general interest to home workshop owners is Mr. Sahlmann's method of rust prevention. He uses old-fashioned sperm oil, which can be obtained at certain drug stores. It is rubbed over the polished surfaces of tools with a clean rag, and the excess oil is then rubbed off with another rag. Tools treated in this manner are not sticky or gummy, yet a sufficient thickness of oil remains. He treats his tools in this way about once a year.

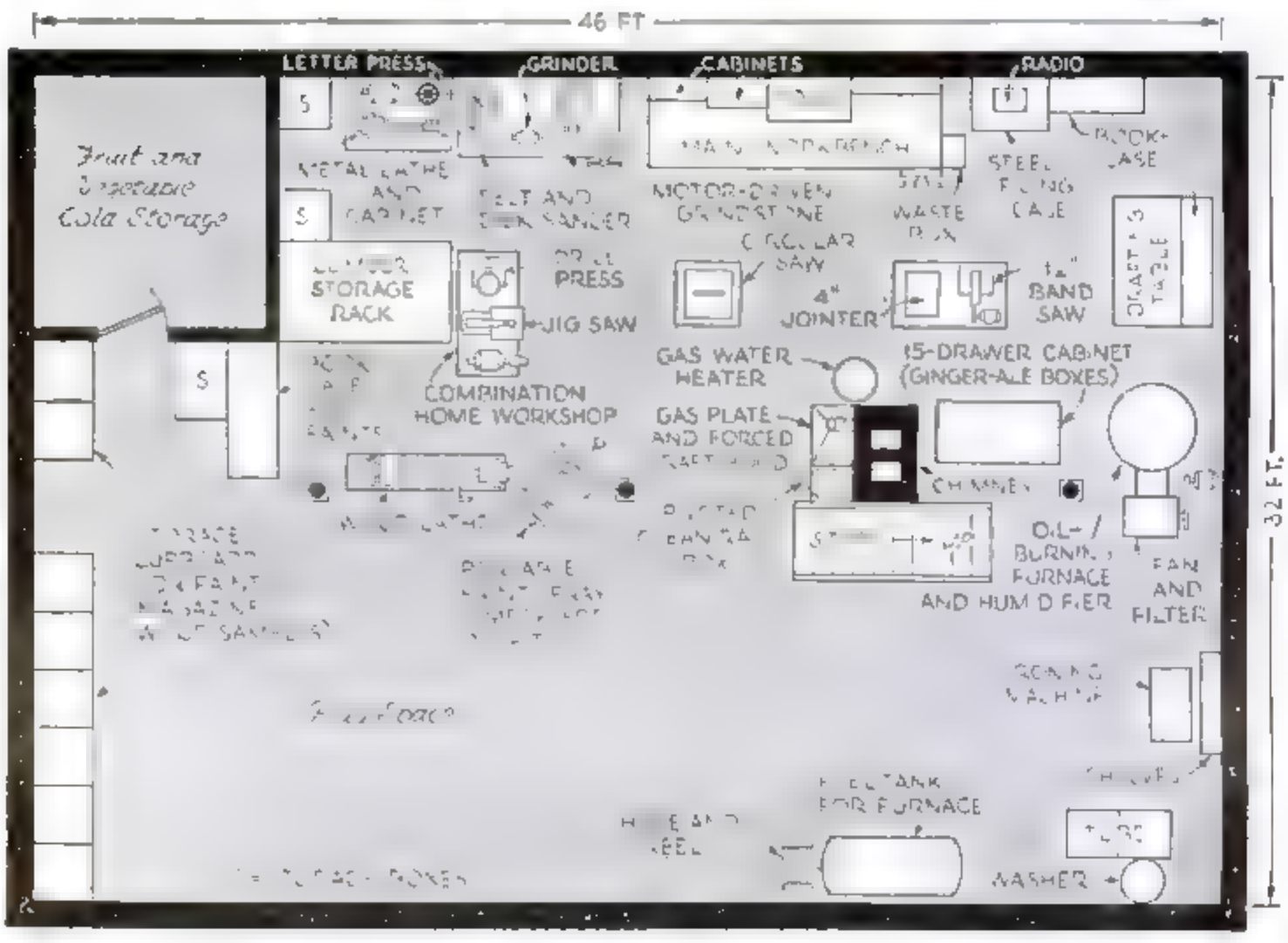
Old ginger-ale boxes and bonded whisky boxes are used as storage bins for odds and ends such as leather, scrap metal, felt, asbestos, and bakelite. One cabinet contains fifteen drawers made of these boxes. A shelf is provided under the workbenches for twelve more boxes of this kind, which have been fitted with covers and labels.



General view of the shop. The machines all have individual motors. Note the variety of cabinets above the main bench

A clear space is kept open the length of the shop. At the far end of the main workbench are the grindstone, belt and disk sander, and a metal lathe and cabinet

Even the lumber storage rack is nearly arranged in this shop. In front of it can be seen the wood lathe and a portable paint-spray compressor outfit. Note the hooded gas plate beside chimney at right



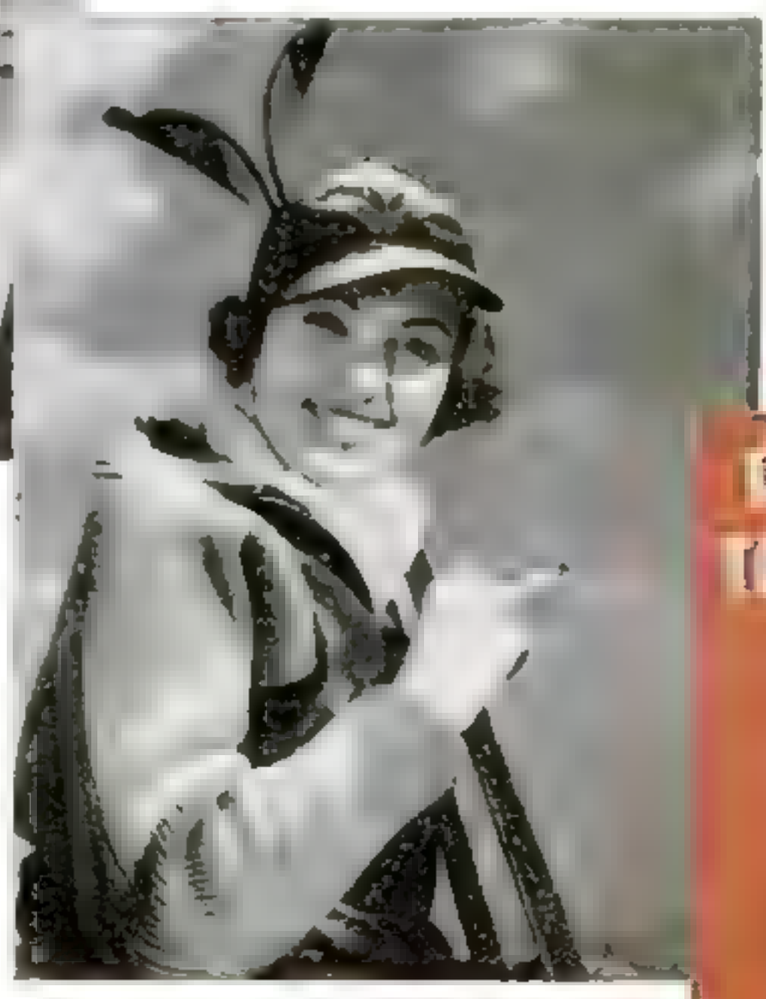
OLD SICKLE GUARD USED AS STAPLE PULLER

WHEN wire fencing has to be removed from wooden fence posts, a simple and effective tool for prying out the staples can be found in a discarded sickle guard such as is used on all mowing machines and binders. One of these can be found in almost any farm junk pile. The only necessary change is to grind a small flat place on the end of the guard where the hammer strikes it.—L. C. PELTIER.

Fencing staples are pried out quickly with an old sickle guard flattened at the end

THE TOWERS OF MANHATTAN from a new angle—New York's new Triborough Bridge, which is rapidly being completed. In the foreground: Howard Hougland, McClintic-Marshall engineer, wearing the picturesque engineers' "hard hat," a necessary protection on big jobs. "An engineer's life is packed with action," he says. "It calls for physical fitness and energy to stand the strain. When my pep is at low ebb, there's nothing like a Camel, for smoking a Camel chases away all signs of tiredness. I always get a 'lift' with a Camel. I also prefer Camel's good taste."

"I AM A STEEL WORKER on the Triborough Bridge," says Ben Parsons (*above*). "When tired, I get a 'lift' with a Camel. Camels have all the full flavor anybody could want."



WINTER SPORTS TAKE ENERGY TOO. But to enjoy the fun you have to be fit. "That has a lot to do with why I prefer Camels," says Margaret Lynam (*left*). "I know that athletes approve of Camels, as they do not affect their wind or nerves. That goes for me too. And Camels renew my flow of energy."

TUNE IN! Camel Caravan, with Walter O'Keefe, Deane Janis, Ted Husing, Glen Gray and the Casa Loma Orchestra. Tuesday and Thursday—9 p.m. E. S. T., 8 p.m. C. S. T., 9.30 p.m. M. S. T., 8.30 p.m. P. S. T.—over WABC-Columbia Network.

- Camels are made from finer, MORE EXPENSIVE TOBACCOS — Turkish and Domestic — than any other popular brand.

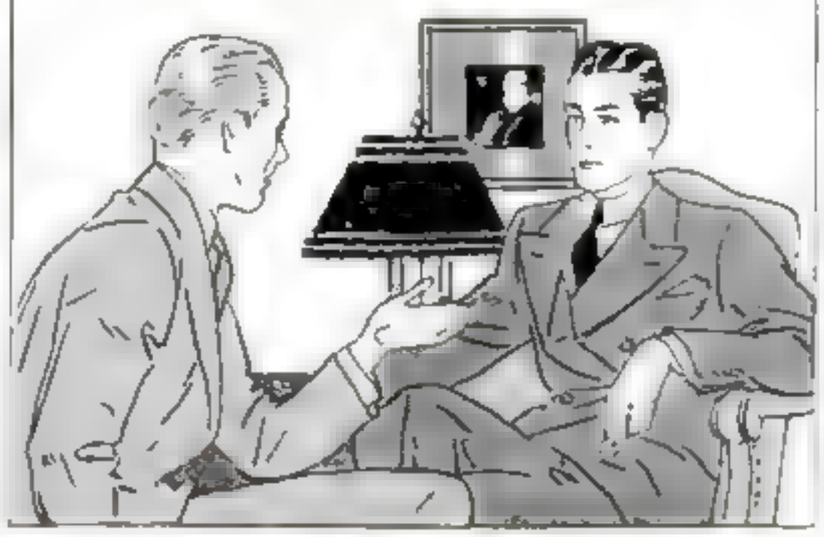
(*Signed*) R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

THOSE "B.O." STORIES CAN'T SCARE ME. I COULDN'T OFFEND

OH YEAH! WELL, JUST READ THIS TRUE "B.O." CONFESSION

One day a letter came to the makers of Lifebuoy. It read—

ANOTHER YOUNG MAN AND I HAVE ADJOINING APARTMENTS. WE SHARE THE SAME BATHROOM. OFTEN HE'D DROP IN FOR A CHAT AND TELL ME HIS TROUBLES



HE WAS A SALESMAN AND SHOULD HAVE BEEN A CRACKERJACK FOR HE WORKED HARD. BUT, INSTEAD, HIS SALES WERE MISERABLE — AND I COULD GUESS WHY!

I DIDN'T HAVE THE NERVE TO COME OUT AND TELL HIM. BUT I WAS CAREFUL TO LEAVE MY CAKE OF LIFEBUOY IN PLAIN SIGHT IN THE BATHROOM

HE KNOCKED AT MY DOOR ONE MORNING. "SAY," HE SAID, "I'VE BEEN USING YOUR SOAP. SMELLED SO NICE AND CLEAN I COULDN'T RESIST." "KEEP IT," I SAID, "IT MAY BRING YOU LUCK"

"LIFEBUOY SURE HAS BROUGHT ME LUCK," HE TOLD ME LATER. "MY SALES HAVE BEEN BETTER EVER SINCE. I'M A LIFEBUOY FAN FOR LIFE. MY TROUBLE MUST HAVE BEEN 'B.O.'"

Yes, we get *thousands* of letters like the one pictured above

ONE LETTER might be disregarded. But you can't laugh off *thousands!* They force us to realize how common, how serious a fault "B.O." (*body odor*) is. Don't risk it. Bathe regularly with Lifebuoy. Its searching lather—abundant in hardest water—purifies pores, stops "B. O." Its own clean scent rinses away. Women find Lifebuoy brings new complexion beauty. It's *deep-cleansing, yet gentle.* "Patch" tests on the skins of hundreds of women show it is more than 20% milder than many so-called "beauty soaps."

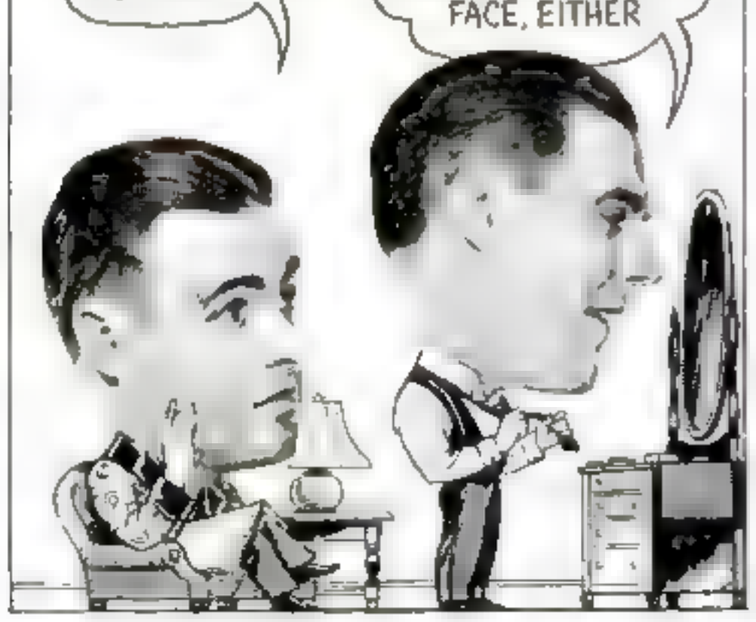
Approved by Good Housekeeping Bureau

Stops 'B.O.'

120 TO 150 SHAVES IN THE BIG RED TUBE

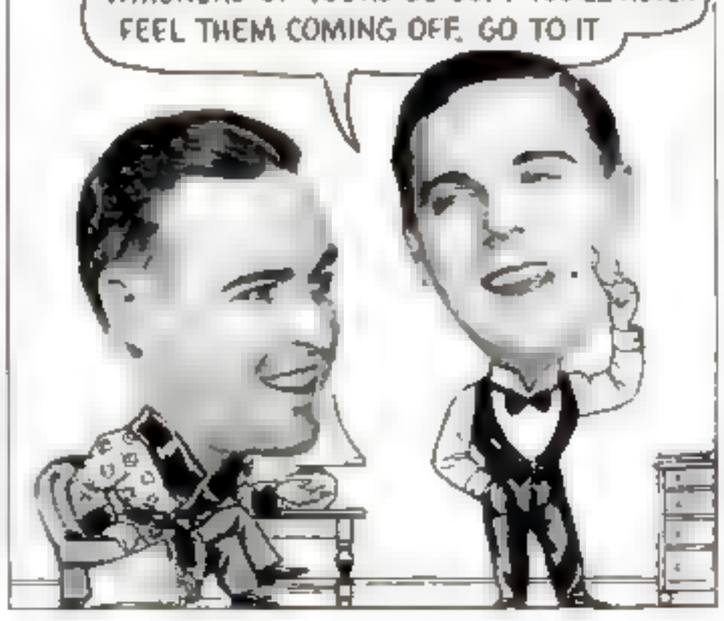
RAY, I CAN'T GO TO THAT DANCE WITH THESE WHISKERS. AND I JUST CAN'T SHAVE! MY TENDER FACE IS ALL SORE NOW—BEARD'S SO STIFF

I HAD THAT TROUBLE, TOO, 'TILL I CHANGED TO THIS NEW SHAVING CREAM. NOW I SHAVE AS OFTEN AS I WISH. NEVER IRRITATES MY FACE, EITHER



WELL, LET ME IN ON IT. WHAT IS THIS WONDERFUL NEW SHAVING CREAM? I'D LIKE TO TRY IT

LIFEBUOY, M'BOY. ITS LATHER HOLDS 52% MORE MOISTURE. IT'LL SOAK THOSE WHISKERS OF YOURS SO SOFT YOU'LL NEVER FEEL THEM COMING OFF. GO TO IT



BY GEORGE, RAY, THIS LATHER IS WONDERFUL EVERY WHISKERS OFF CLEAN AS A WHISTLE AND MY FACE FEELS SWELL!

Send for a FREE Trial Tube

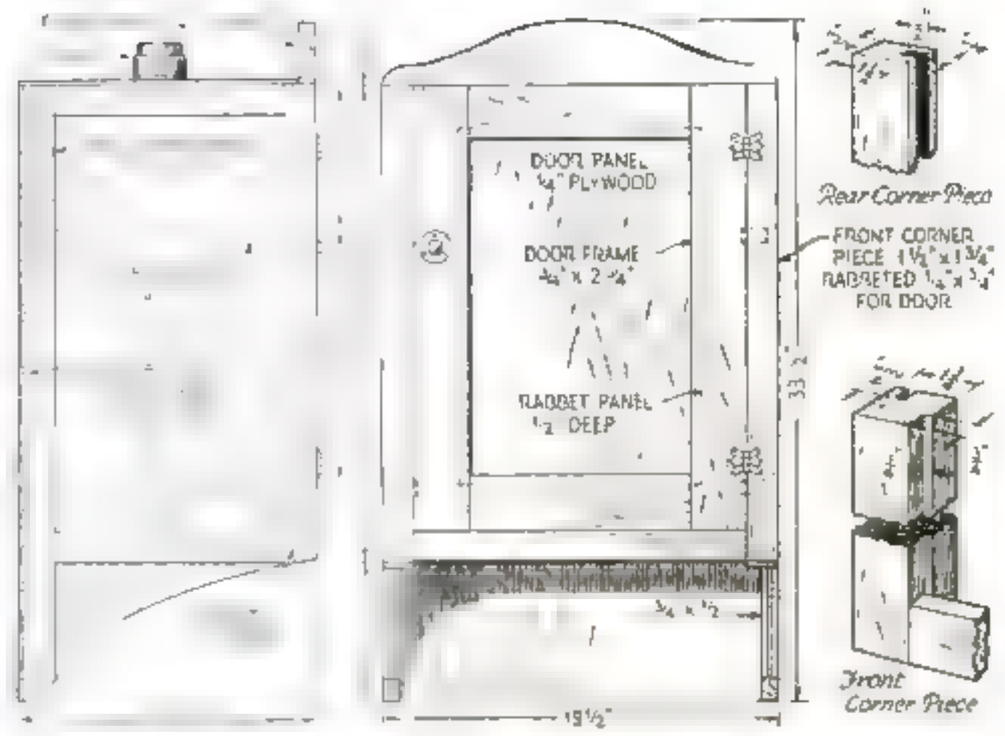
Try this mild, extra-moist lather. Get the big red tube at your druggist's. Or write Lever Brothers Co., Dept. A142, Cambridge, Mass., for a free 12-day tube

(*This offer good in U. S. only*)

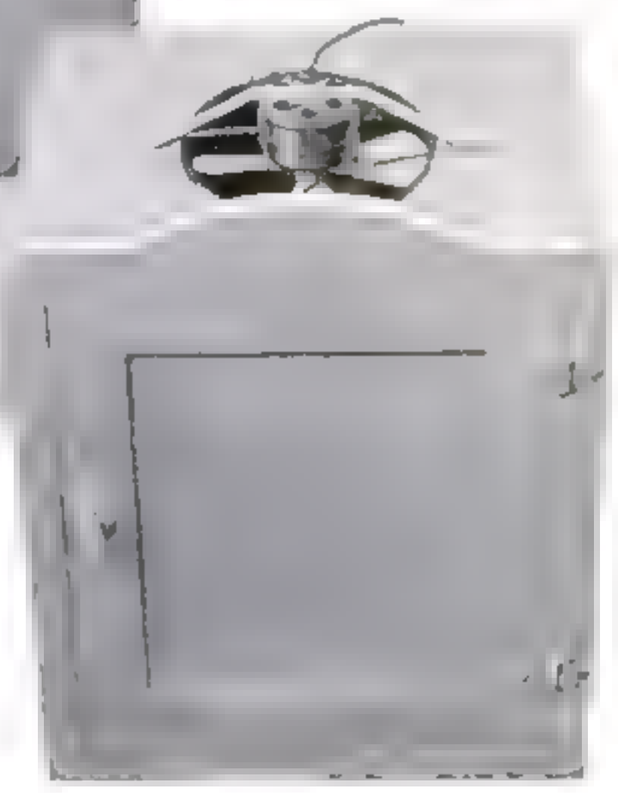
TRY IT! SEND FOR YOUR FREE TUBE TODAY

LIFEBUOY Shaving Cream

Easily Built Dish-Drying Cabinet



When washed and rinsed, the dishes are stacked in trays, placed in the cabinet, and dried by turning on the fan for a few minutes



THE task of wiping dishes dry may be eliminated and many steps saved by building a drying cabinet like that illustrated. It is especially adapted to small kitchens where there are no built-in cupboards or where the pantry is not easily accessible.

The dishes are washed in hot soapsuds, rinsed in clear hot water, and stacked in wire trays, which slide into the cabinet. The door is then closed and the fan plugged in for about five minutes. After being dried in this manner, the dishes may be left where they are until the next meal.

The dimensions given are for standard wire drainers 4 by 12 by 16 in. Two are sufficient to hold all the dishes and silverware necessary for a family of four or five. White pine or other softwood is used for the framework, and ¼-in. fir plywood or composition board for the panels and back. The bottom of the side panels are sawed to the shape shown to make a neat finish. The rabbets in the front and rear corner pieces are coated with glue, preferably casein, the panels are slipped in, and each side assembly is laid aside until dry. Pieces of plywood 1½ in. wide are then nailed on the sides with finishing nails to simulate a paneled effect. A piece of plywood ¼ by 30½ by 19½ in. is nailed to the back, and the top is a piece 19½ by 14 in., set ¾ in. back from the front edge of the cabinet.

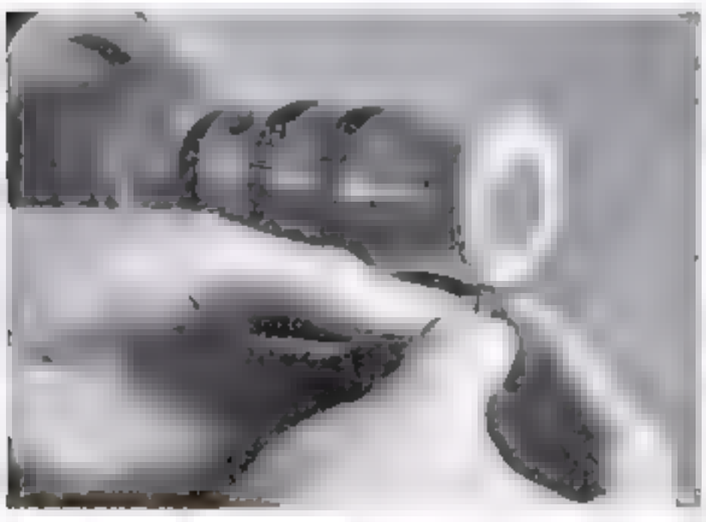
Before the top is attached, the hole for the fan blades and guard should be cut. The piece for the front at the top is shaped approximately as shown and nailed to the corner pieces. The bottom of the cabinet is left open for drainage.

The door frame is made as shown and attached with two butterfly surface hinges or ordinary butt hinges. A latch of any desired type completes the door hardware.

Tray holders ¾ by 1½ in., or wide enough to support the edges of the wire baskets, are fastened from the outside at the points indicated with 1½-in. No. 8 flathead screws.

An inexpensive 8-in. electric fan, with base removed, is fastened in the hole previously cut in the top with a ⅛ by ½-in. strip of flat iron or brass. This is fastened to the motor and the top of the cabinet with machine screws as shown in the drawings and in the photograph taken from above the cabinet.

Paint the cabinet inside and out with three coats any appropriate color. Attach the dish drier to the wall with four 2-in. No. 12 flathead screws.—STELLA BONNER and WILLIAM JACKSON.



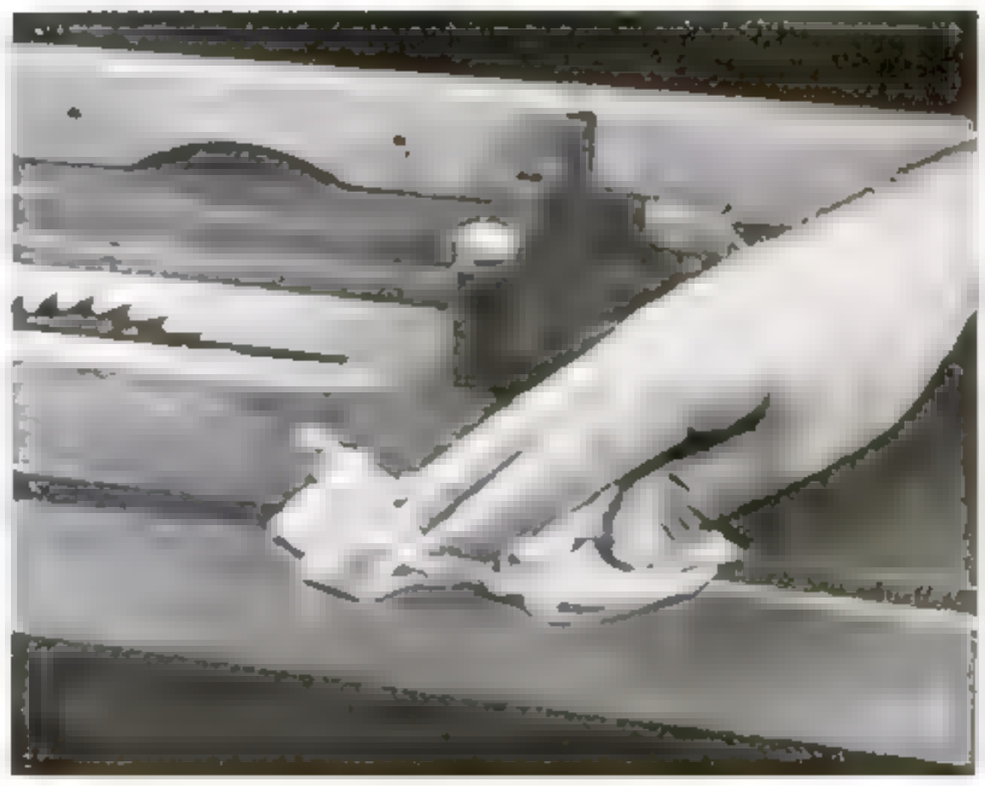
POLISHING WITH ERASER

A FLAT typewriting eraser is an excellent substitute for a polishing wheel in cleaning up delicate metal parts of models and other small work. Such an eraser is soft and just gritty enough to polish without endangering the piece. The eraser is mounted on a wood screw, which in turn is held in the polishing-head chuck as shown above.—DANIEL REYNOLDS.

WAXED PAPER GIVES TOOLS PROTECTION

ORDINARY waxed paper, such as is sold for wrapping sandwiches and foodstuffs, is convenient for lubricating and protecting shop tools and the exposed surfaces of machines. It is rubbed over the steel and leaves a slight deposit of wax—sufficient to prevent rust, yet not enough to make the surface oily or gummy.

If a large sheet of waxed paper is crumpled up and rubbed over the surface of a saw table, particularly in the gage track, the gage will work much more smoothly and the top will be protected against rust.

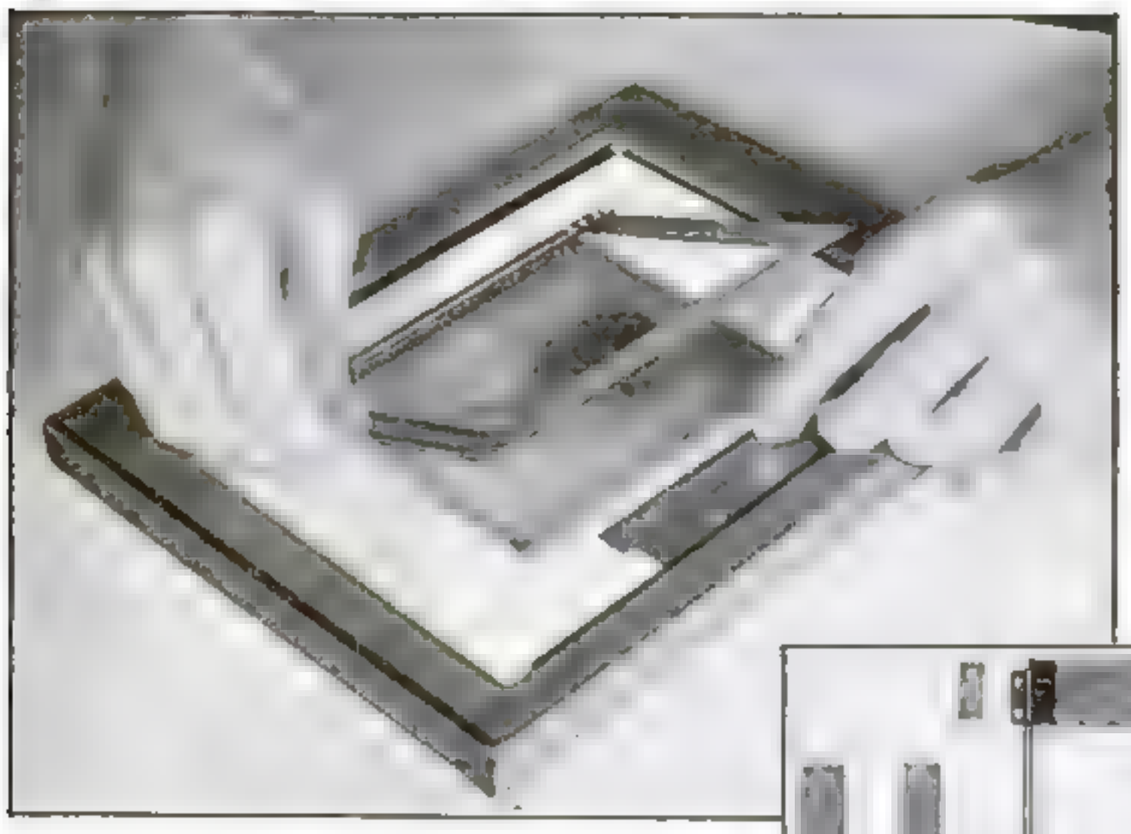


Rubbing the surface of a saw table and the gage track with waxed paper to make the gage work smoothly and to protect against rust

SAVE time by using our simplified construction kits, listed on page 84.

HOMEMADE Photo Accessories

Glassless negative holder for enlarging, collapsible lens hood, adjustable masks, focusing magnifier, and other timesavers



The clamp is dropped over the negative and held by a sliding catch. The parts shown at right are, in order, the covering plate, three spacers, large clamp, another spacer, and sliding catch

The lens hood shown above can be left permanently in place. A length of music wire is annealed, coiled into shape, stretched to the desired length, and hardened. This collapsible frame is covered with any dark cloth

By IVAN C. LUCKMAN

PHOTOGRAPHIC accessories are not only great timesavers, but their convenience is often responsible for the amateur's continued interest in photography as a hobby. Unfortunately, many of them are expensive, and, being designed for the average user, do not always exactly fit the needs of the individual. In such cases it is usually possible to devise a homemade substitute.

In most darkrooms, particularly during the winter when the air is dry and dusty, it is very difficult to keep the cover glasses in the negative carrier of the enlarger free from lint and dust. A negative holder is illustrated above that does not use any glasses yet holds the negative flat. In addition, it does not retain the heat from the light as much as a glass carrier.

A piece of veneer is cut to fit the carrier, and in the veneer a hole is cut slightly smaller than the outside dimensions of the negative. Paint the wood white so that you can easily see to locate the negative over the opening. The device for clamping the negative in place is made from 3/32-in. thick brass, and its opening should be the exact size of the opening in the wood. This brass clamp is mounted by means of two hinges soldered to its legs. It is a good plan to remove the hinge pins from the two hinges and replace them with a single long wire pin that connects the two so there will be no trouble in aligning the hinges while they are being soldered. Be sure to put spacers between the hinges and the board when assembling. Small bits of scrap film will do for the spacers.

A sliding catch, movable by means of the two slotted holes shown, is then screwed in place at the bottom end of the frame. If carefully made, it should be very difficult to move the negative after the clamp has been locked.

Many exposures are either lost or ruined because of the *(Continued on page 91)*

Exact focusing is made easy with this inexpensive magnifier, fitted with a clock-spring clamp. It goes on the camera as shown above

The semicircular device shown in two views above helps in enlarging. The spacer of tubing should be just long enough so that the segment will clear the front of the lens by about ⅛ in.

An adjustable border mask made from a worn-out ferrotype plate is illustrated at the right. The two L-shaped pieces are held together by two sliding clamps made as in the smaller photo above

$2500.00 for PICTURES AT NIGHT

A picture like one of these may win you $350.00

HERE'S your chance to discover a fascinating, new indoor sport—and try for a valuable cash award as well. Do it tonight.

No special skill is required . . . there's no expensive equipment to buy. Just make a picture at night, indoors or out. It's easy to do with Mazda Photoflood or Photoflash lamps and Kodak "SS" or Kodak Verichrome Film. And you don't need any expensive equipment . . . your present camera will do, if it can be set for "time." Read the simple rules . . . try for an award—*tonight.* Eastman Kodak Company, Rochester, N. Y.

89 Cash Awards monthly

during January, February, March, 1936:

2 awards of $100 ea. • 3 awards of $50 ea.
4 awards of $25 ea. • 10 awards of $10 ea.
20 awards of $5 ea. • 50 awards of $2 ea.

$250 GRAND AWARD

A $250 Grand Award will be given to one of the six winners of the $100 award; hence, the grand award winner receives $350 for a single picture.

KODAK "SS" FILM . . . indoors or out, day or night, this film steps up any camera's picture-making range. Ultra-sensitive to the rays of artificial light, it is ideal for night pictures.

RULES

1 Any number of pictures made on or after January 1, 1936, may be entered. Entries must be postmarked not later than midnight of February 15, March 15, and April 15—the three closing dates. Contests are open to any amateur in the United States and Canada (except employees of Eastman Kodak Company and those engaged in the manufacture or sale of photo supplies).

2 Prizes will be awarded *only* for pictures made at night, either indoors or outdoors, by artificial light. Winners will be chosen solely on subject interest and appeal, not on technical excellence. The decision of the judges shall be final.

3 Each prize-winning picture with negative and sole rights for advertising, publication, and exhibition in any manner shall become the property of the Eastman Kodak Company. If winning picture is of a person or persons, their (or, if under 21, the parent's) written consent to use the picture must be furnished before prize can be awarded.

4 Each print must bear, on the back, your name, address, make of camera, kind of film, and lights. No prints can be returned. Be sure to keep the negatives.

Mail prints only to
Prize Contest Office, Eastman Kodak Company, Rochester, N. Y.

Accept nothing but the film in the familiar yellow box.

FREE —a booklet, all about Night Pictures

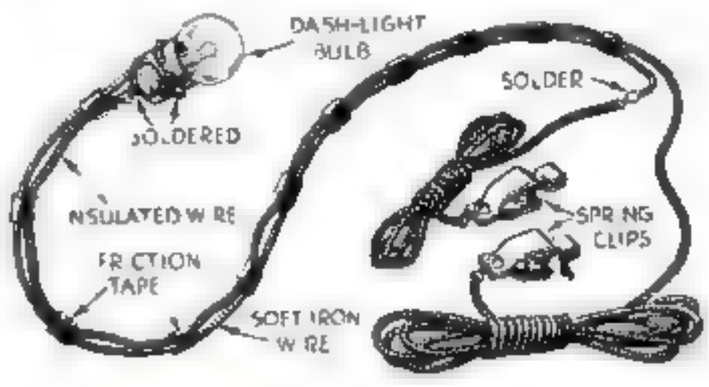
Write for your copy of this booklet, or get it from your dealer, today. It gives complete information about Night Pictures . . . what film to use . . . how to set your camera . . . where to place the lights . . . suggests subjects. Eastman Kodak Company, Rochester, N. Y.

Timely Hints
FOR CAR OWNERS

Bent radiator-grille rods being straightened with clothesline

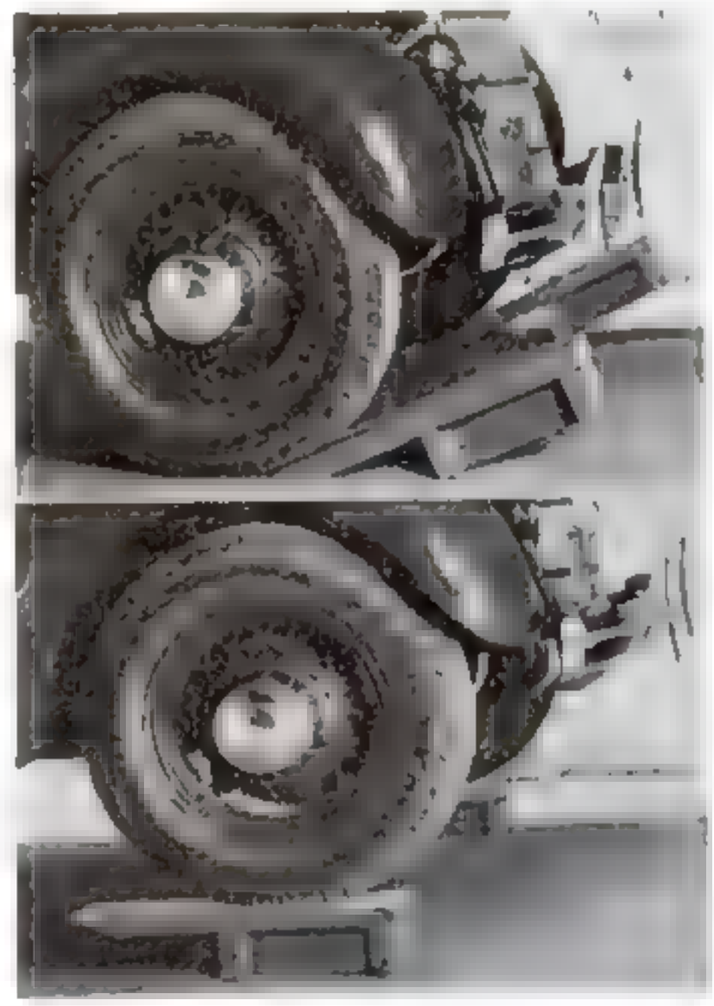
"Gooseneck" Trouble Light

WHILE extracting a loose bolt from the flywheel housing on a car recently, I devised the "gooseneck" trouble light shown. Selecting a 7/16-inch dash-light bulb, I first soldered a six-foot length of flexible insulated wire to the center base terminal. Then I soldered a length of soft iron wire to the outer shell of the base. Finally, to the ends of both wires I soldered spring clips. The clip from the iron wire is attached to the car frame, while the insulated wire is clipped to the opposite battery terminal. Being pliable, the iron wire can be bent into almost any shape to fit into any size opening.—J. A. B.



Fixing Radiator Grille

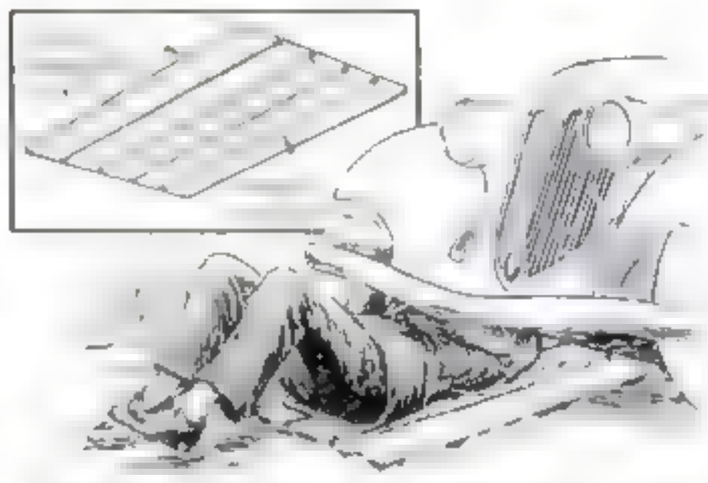
IN AN accident recently, the decorative radiator grille on my new car was bashed in. When a garage man told me what it would cost for a new unit, I decided to try and straighten the old one myself. First of all, I secured a piece of strong, small-diameter clothesline. Looping the rope around one of the damaged uprights, I pulled cautiously but firmly. Bit by bit, I coaxed the bent rod back into place and in less than an hour I had taken the kinks out of all the uprights and the grille was back in shape and as good as new again.—J. P. W.



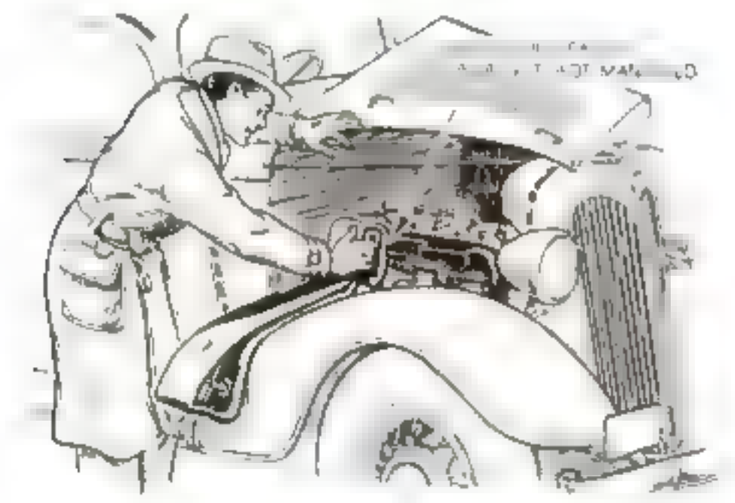
At top, the wheels are being run onto the inclined ramps. Above, ramps in level position

Handy Portable "Dolly"

FROM a sheet of asbestos or wall board, the car owner can make a handy portable "dolly" to protect his clothes when making repairs under his car. It consists simply of five slats, each six inches wide, hinged together with strips of stout canvas or leather. By placing the hinges on alternate sides as shown below, the "dolly" can be folded.—J. L. M.



Folding "dolly" in use for roadside repair work



Removing Tire Patches

OLD tire patches can be removed quickly by making use of the heat of your car's exhaust manifold. Simply hold the tube and patch against the hot surface of the pipe for several minutes. When the patch is thoroughly warmed, it can be peeled off easily without damaging the surface of the inner tube.—E. J. N.

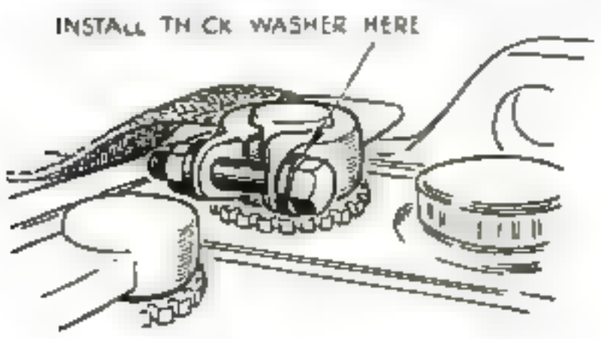
Automatic Lifting Ramps

PORTABLE ramps that will lift a car automatically can be made from two pieces of heavy planking and a few scraps of two-by-four. To raise the car, the ramps are placed in front of the wheels as shown in the top photograph. As the car is driven forward under its own power, the wheels climb the ramps and, when the weight passes the center supports, tip them into a horizontal plane.—P. R. T.

Sleetproofing a Wiper

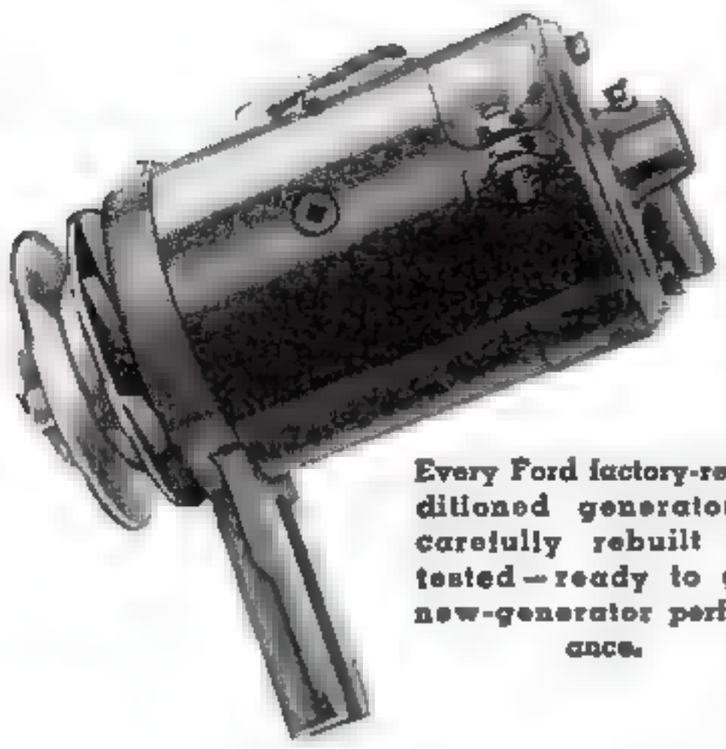
BY ALTERING your regular windshield wiper slightly you can make it work effectively during the heaviest sleet and snow storms. Fold several thicknesses of soft cloth over the rubber wiper blade to form a pad, and fasten it in place with two rubber bands placed at the ends. Then soak the pad in glycerin. One application lasts for several storms.—K. M.

Washers Keep Cable Bolts from Sticking



BECAUSE the bolts on most battery-cable terminals are set in recesses to prevent turning, they are difficult to loosen when they become corroded. To prevent this, place a thick washer under each bolthead the next time you change cables. They will hold the boltheads free of the recesses and allow the bolts to be turned and rocked.—E. T. G., Jr.

FORD FACTORY-RECONDITIONED GENERATORS



Every Ford factory-reconditioned generator is carefully rebuilt and tested—ready to give new-generator performance.

THE Ford plan of factory-reconditioning the engine and other units and making them available to all Ford car and truck owners at low cost is one of the big advantages of Ford ownership.

The same Ford methods used in building the new Fords are used to recondition these exchange units. In the River Rouge factory at Dearborn, complete facilities are available—production methods are used—experienced men do the work. The units get careful inspection and production tests. That's why the work is right and exchange prices are low.

The generator is one of more than a dozen units included in the Ford exchange plan. These generators

The electrified conveyor supplies current to operate these generators until they are removed at the end for output test.

These large presses insert the bushings in the generator endplates and then burnish them to accurate size.

are reconditioned in the Ford generator plant—the same plant where all Ford generators are built.

In the reconditioning, the exchange generators are completely torn down. The parts are washed, then carefully inspected. All parts that are worn or damaged are thrown out. That's why many of the parts in the rebuilt generators are new parts. After assembly, these generators must pass the same tests as new ones. That's why they give new-generator performance.

The cost to the owner is actually less than for replacing the armature and brushes alone. And since the exchange is made quickly, the owner also saves time. This exchange service can be had from every Ford dealer.

FORD MOTOR COMPANY • DEARBORN, MICHIGAN

GENUINE Ford PARTS

BUILD VALUABLE SHIP MODELS WITH OUR

Construction Kits

KIT 4S—Materials for *Great Republic*

IF YOU have advanced beyond the simplified ship model stage, you will find it well worth while to begin work on one of our standard models. Eleven of these kits are available, the latest being one for the famous American clipper ship *Great Republic*.

These eleven standard models are the finest of the many scale models Capt. E. Armitage McCann has designed for this magazine. Their value, when finished, is from twenty-five to several hundred dollars each, according to the workmanship. Each of them requires a number of different kinds of hard-to-get materials, and if you go out shopping for the individual items yourself, you will waste at least half a day's time and will have to buy much larger quantities than you have any need for. Besides, you will probably have to take some substitutes that will not give entirely satisfactory results in the finished model.

Our kits, on the other hand, are complete assortments of carefully selected raw materials. The blocks or "lifts" for the hull are sawed to shape, and the various strips of wood are cut to the correct width and thickness. Wire, rigging cord, brass, fiber, celluloid, chain, tubing, and all the small supplies are of the right size and quality.

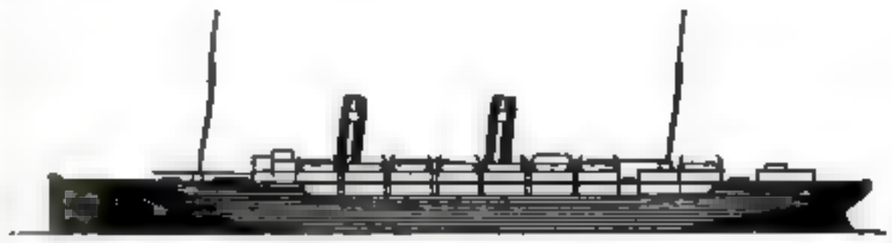
The following is a complete list of our construction kits. Each is accompanied by the necessary blueprints or instructions.

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S. S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
U. *Hispaniola*, the ship in "Treasure Island," 7-in. ..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50
3M. Yacht *Nourmahal*, 8⅛-in..... 1.00

STANDARD SHIP MODEL KITS

A. Whaling ship *Wanderer*, 20½-in. ...$7.40*
D. Spanish galleon, 24-in..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 7.25*
L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull.... 4.95†



KIT O—An 11-in. model of the S. S. *St. Louis*

V. Clipper *Sovereign of the Seas*, 20½-in. hull ..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in. hull 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull 6.50*
4S. Clipper ship *Great Republic*, 31½ in. hull 8.40*

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5⅛ in. high..... 1.50

No. 8. Whittling kit for six Scotties. Each dog is 2 by 2¼ in. and sawed to shape..... 1.00

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States or Canada. The kits marked with an asterisk or dagger will be sent C.O.D. in the United States upon request, but the purchaser will have to pay 28 cents additional.

NO. 7
Whittling Kit

KIT Q
Swallow

Popular Science Monthly,
353 Fourth Avenue, New York, N. Y.

Please send me Kit.....for

which I inclose $.....(or send C. O. D. ☐)

Name .....

Address .....

City..... State .....
(Print name very clearly.)

Remit by money order, check, or registered mail. No kits selling for less than $4.00 can be sent C. O. D. This offer is made only in the United States.

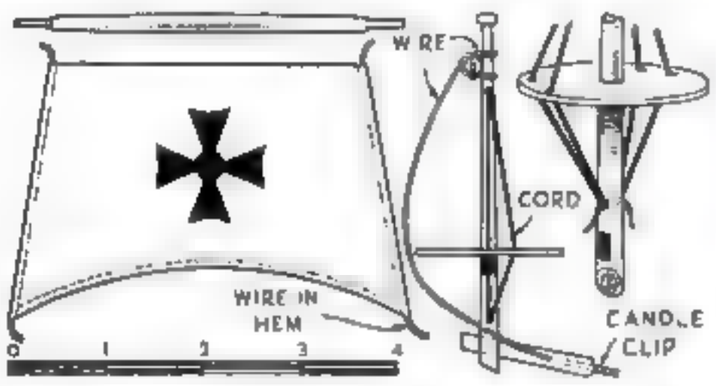
MINIATURE SAILS SERVE AS CANDLE SHADES

(Continued from page 66)

short dowel, drill a hole into which the bar of the clip can be firmly fitted.

From a simular dowel make the yards as shown, 4 in. long. The tops are disks of wood of 1½-in. diameter, with holes to fit the masts tightly and other holes for the shrouds.

In the masts bore holes as shown to take two parts of cord above and to take three parts below. Reeve the tops on the masts; then reeve cord through the holes in the tops and the holes in the masts, with both ends passing through the lower holes. Draw them



How the sail and yard are made and set up, and a sketch showing shape of the mast top

tight, fasten off with glued pegs, and cut close.

I made the sails of a scrap of rough, yellow silk, but any suitable material can be used On them can be painted red crosses. They should be hemmed across the foot and down both sides, using the selvage for the head, if possible.

Now take pieces of thin wire about 12 in. long; reeve them through holes in the bowsprits and reeve each end up through the hems in the leeches (sides); drill holes through the yardarms and pass the ends *down* through these. The heads of the sails can be hitched or glued along the yards.

With pieces of wire fasten the yards to the masts. Hold the middle of the wire behind the mast, carry the ends over the yard and around them, then back around the mast underneath. Twist the ends together tightly. Now adjust the side wires so that the sails belly and the lower bights act as sheets to hold the corners out and back. Large beads will serve for trucks at the mastheads, or they can be turned.

The wooden parts are best stained brown. Do as much or as little antiquing as you like, and add suitable flagpoles and flags, if you wish.—P. O'N.

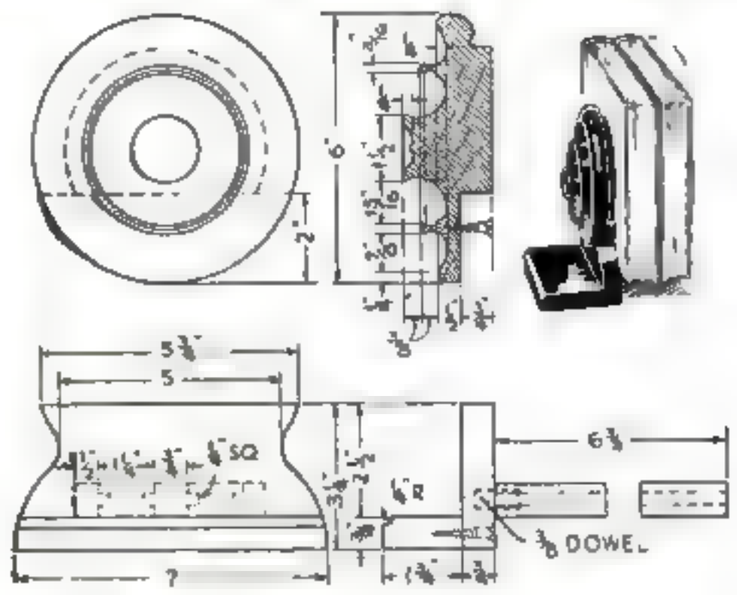
RESURFACING PULLEYS

BY A SIMPLE method I have discovered and frequently used, it is possible to improve a home workshop pulley that slips or even build up its face to a larger diameter for the purpose of changing the speed of a machine. The pulley to be resurfaced must be cleaned very thoroughly and roughened with a file or emery cloth. Then, to obtain a surface with the best nonslipping characteristics, prepare a mixture of three parts coarse sawdust to one part powdered asbestos and add sufficient water glass (sodium silicate) to make a cement. Spread this on the pulley with a flat blade. If a harder and more lasting surface is desired, use two parts of asbestos to one of sawdust. The asbestos is the type used to insulate house-heating boilers and commonly sold at hardware stores. The more of it is used, the harder the surface will be. If the mixture is kept in a pail set in warm water, the cement can be spread more easily. Also dip the blade frequently in warm water. Let the resurfaced pulley stand for at least twelve hours before being used. Allow more time if possible. What is of even greater importance is to make sure that the pulley is absolutely clean before starting.—W. PHAIR.

TURNED ROSETTES SERVE AS BOOK ENDS

LARGE rosettes, turned on the lathe, form the end blocks of the adjustable book rack illustrated in the drawings at the right. The rack itself is of a familiar type, with a bottom made of tongued-and-grooved members so that the ends may be moved in or out to suit the number and thickness of the books. Metal strips hold the ends of the slides from spreading and serve as stops.

The rosettes, after being turned to the design shown or to any other that appeals to the craftsman, are cut out as shown to fit over the end pieces and are attached with glue and screws driven from the inside. The original book ends were made of walnut and faced inside with velvet.—BIL GREDICK.



BLUEPRINTS FOR YOUR NEXT PROJECT

BEFORE you start a new project in your home workshop, make it a point to study our list of blueprints for suggestions. The following is a selected list, but many other plans are available. Send a self-addressed, stamped envelope for our complete list.

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 84.}

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Civil War Ships *Monitor*, *Merrimac*, and *Hartford* (3⅛, 5⅜, and 5⅛ in. long respectively), *258*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper Ship *Great Republic* (31½-in. hull), *272-273-274*	1.00
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Brooklyn* (8-in.), *236*	.25
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25
Freighter, Ocean (14-in.), *271*	.25
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
H. M. S. *Bounty* (8½-in. hull), *254*	.25
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Motor Boat, 29-in. Cruiser, *63-64-R*	.75
Motor Boat, Working Model (20-in.), *196*	.25
Nourmahal, power yacht (8½-in.), *276*	.25
Liner—*Aquitania* (9-in.), *225*	.25
Liner—*California* (12½-in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Manhattan* (12-in.), *204*	.25
Liner—*St. Louis* (11-in.), *231*	.25
Pirate Felucca (20-in.), *44-45-R*	.75
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Roman Galley (19-in.), *138-139-R*	.75
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Show Boat, Illuminated (14-in.), *263*	.25
Stagecoach with Horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Trading Schooner (17½-in. hull), *252-253*	.50
"Treasure Island" *Hispaniola* (7-in.), *237*	.25
Viking Ship, (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Five-Tube Short Wave (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

FURNITURE

Chests, Treasure, *78*	.25
Child's Costumer, *179A*	.25
Coffee Table with Spiral Legs, *245A*	.25
Double-Decker Bed for Boy's Room or Cabin, *277A*	.25
End Table, American Empire, *241A*	.25
Fireside Seats (wood and metal), *266A*	.25
Floor Lamp with Tripod Base, *243A*	.25
Lamps, Three Modern, *93*	.25
Magazine Rack, Ladder-Back Style, *250A*	.25
Mirror Frame, 20 by 30 in., *246A*	.25
Pier Cabinet and Hanging Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25
Sewing Cabinet of 1812, *178A*	.50
Sewing Cabinets, Two, *31*	.25
Silverware Chest on Stand, *256A*	.25
Smoking Stand, Modern, *238A*	.25
Stool, Scoop-Seat, *242A*	.25
Stool, Upholstered, *240A*	.25
Table, Four-Leaf Card, *239A*	.25
Tables, Tile-Top, *249A*	.25
Tavern Table and Scroll Mirror, *105*	.25
Treasure Chests, *78*	.25
Welsh Dresser, *60*	.25

BOATS

*Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257*	.25
Installing Inboard Motors, *270*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50
*13-ft. Racing Runabout, *261-262-R*	.75

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra.

TOYS

Doll's House, Colonial, *72*	.25
Doll's House, Furniture, *73*	.25
Projector for Photos and Pictures, *259A*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

MISCELLANEOUS

Bird House, Log-Cabin, *244A*	.25
Candleholders or Candelabra of Scroll Design, Wooden, *278A*	.25
Drafting Table, *189A*	.25
Hand Loom, Four-Treadle, *268A-269A*	.75
Knitting Bag with Wooden Frame, Book Ends, and Collar Holder, *267A*	.25
Microscope Kit, Portable, *220*	.25
Night Lamp and Sewing Kit, *255A*	.25
Perpetual Star Chart, *214*	.25
Radiator Inclosures, *278A*	.25
Six Simple Block Puzzles, *65*	.25
Tie Rack, Extension Book Rack, and Turned Box, *247A*	.25
Weather Vane, Ship Model Type, *66*	.25

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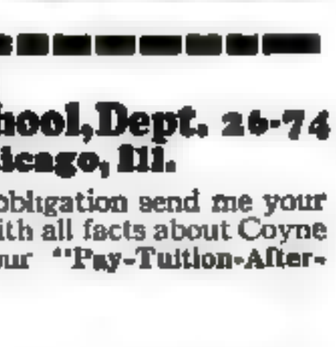

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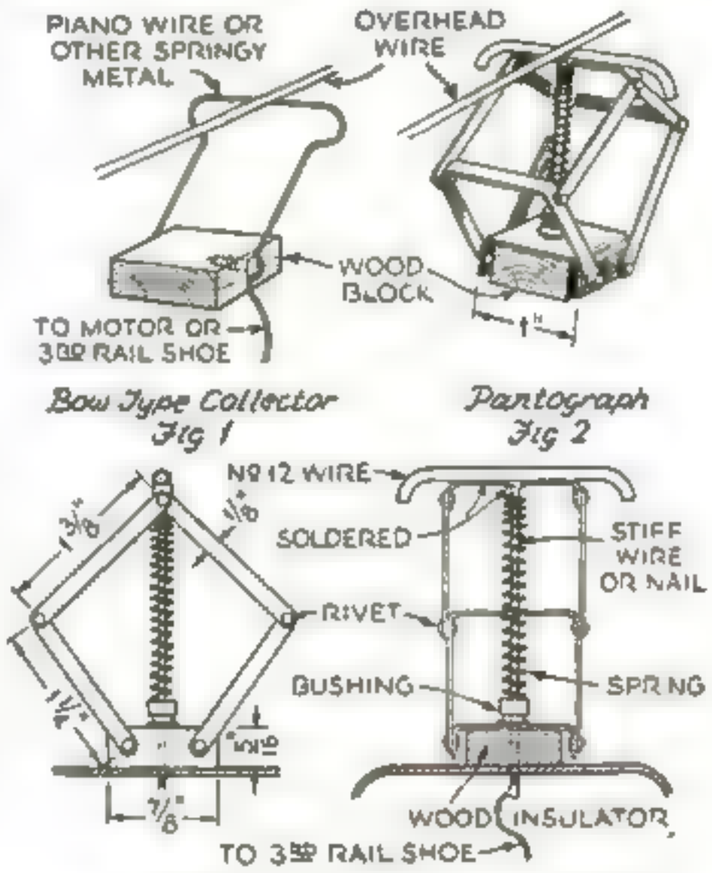
TROLLEY SYSTEM FOR MODEL RAILWAY

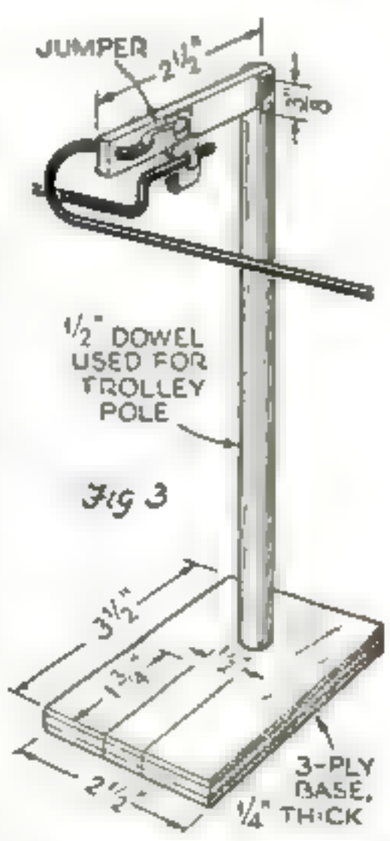
HERE is a suggestion for model-railway fans who find the purchase of third-rail track a strain on their finances. For about four cents a foot, you can electrify ordinary mechanical track with a portable overhead system. Built in sections, it is well adapted to block signals or other control methods. And by equipping third-rail track with the system, you may operate two trains under separate control, or use the added circuit for any number of interesting remote-control schemes.

Your locomotive must be provided with either the simple bow collector of Fig. 1, or preferably with a pantograph like that in Fig. 2. The latter is assembled from narrow strips of sheet brass, loosely riveted together with tiny aluminum or copper rivets.

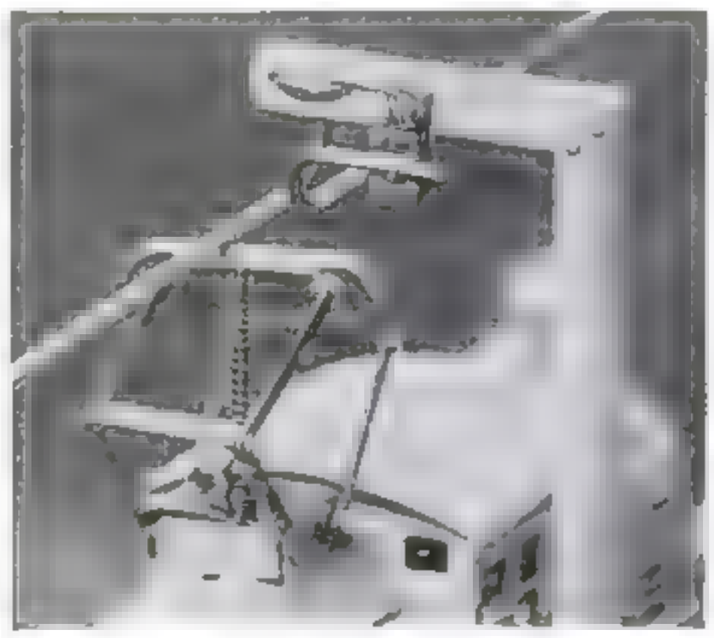


Details of Pantograph Shown in Fig. 2

Figure 3 shows the overhead details for O-gauge track. Trolley poles consist of ½-in. hardwood dowels, cut about 1¼ in. longer than the height of the pantograph shoe above the track. Slots at the top receive the cross arms, which are plywood strips. The poles are screwed to plywood bases in which two parallel saw cuts have been made, ½ in. apart and 1¾ in. long, to accommodate the metal ties of the track. Place the poles at the middle tie of every other section of track, bending the sides of these ties parallel so they will slide snugly into the saw cuts.



Each section of trolley wire consists of a 25-in. length of No. 12 wire, either hard-drawn copper, brass, or copper-clad iron. The latter is recommended for its stiffness, which is useful on the curves. One end of each section is firmly anchored to the cross arm by forcing it through holes in the wood and bending the end over. The other end of the

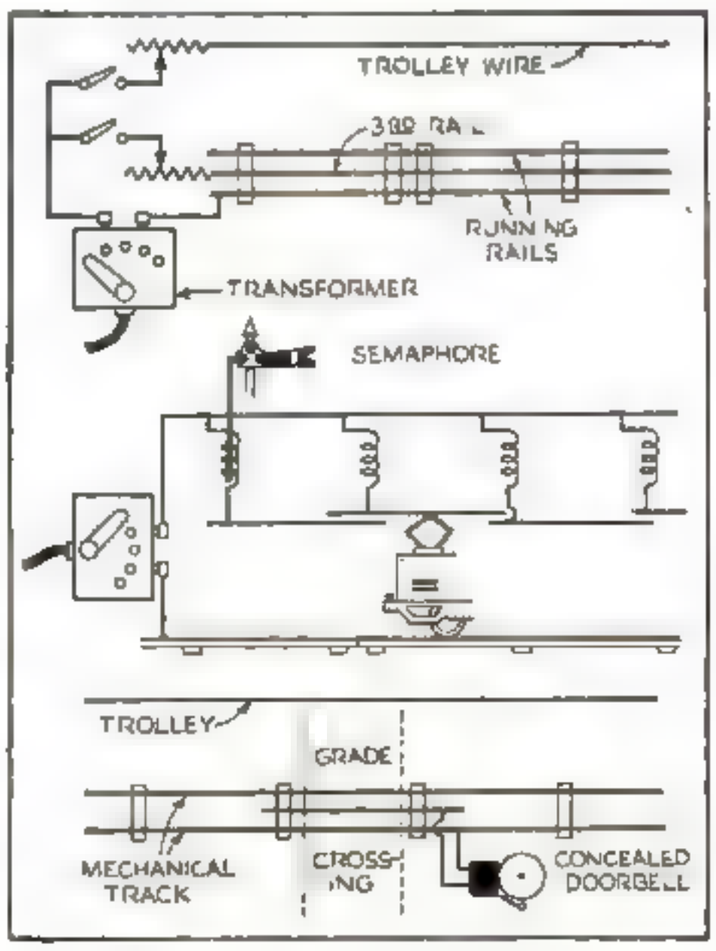


Close-up of pantograph and cross arm of pole

section is gripped in a Fahnestock clip at the next cross arm. At each pole the wires overlap for an inch or so.

Ordinarily, the sections will be connected by a "jumper" at each cross arm, and the power transformer wired direct to trolley wire and track. For a permanent layout, you may wish to replace about every third jumper by a switch leading to a feeder wire. This method allows several trains to be operated at one time. The sections may also be connected to a feeder wire through low-resistance magnets which operate semaphores.

If third-rail track has been used, the trolley wire and third rail should be supplied through separate rheostats or transformers. One train then draws its power from the trolley, the other from the third rail, and they are under independent control. The third-rail circuit could also be used for remote control of the locomotive bell, couplers, or reversing relay. And, as a final suggestion, why not have part of your system third rail and part overhead trolley?—CHARLES D. SAVAGE.



The first diagram shows how to operate two trains independently on the same track; the second, a block-signal circuit for electrified mechanical track; the third, a section of third rail for operating a warning signal

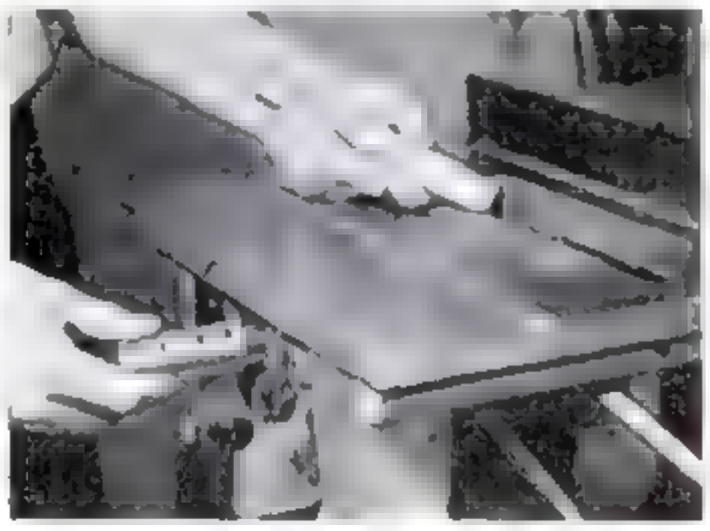
IMPROVING EFFICIENCY OF CIRCULAR SAWS

Touching up the teeth occasionally with a slip stone helps keep a saw in good condition

NO MATTER how carefully a circular saw is filed, it begins to grow dull before it has been used an hour on hardwood. The interval between filings may be prolonged considerably by going over the teeth with a slip stone, tapering the rounded edges back to needle-sharp points. One or two quick strokes are all that are needed unless the saw is very dull. This treatment is especially recommended when working with brittle cabinet woods.

Commercial plants use beeswax or paraffin to lubricate circular saw blades. This enables them to slide through narrow cuts without binding, prevents overheating, and lessens the tendency to gum when cutting wood with a high pitch content. Many a home workshop planer saw has been ruined because it has been forced to cut hardwood when running hot. Keep a candle on hand, and apply it generously every time you use the saw. Press the candle against the saw and rotate the arbor. The heat of operation will distribute the melted wax

Wash your saws with kerosene or gasoline periodically, and never put them away without first coating them with vaseline or cup grease. The same treatment given to all of your edged tools will prevent microscopic rust.—ALEXANDER MAXWELL.



To lubricate the blade, a candle is pressed against it while the arbor is turned by hand

IMPROVISED RUBBER RIM FOR SMALL BAND SAW

HERE is a kink to aid operators of small band saws ranging from 10 to 16 in. in wheel diameters: A cross section of an inner tube, I have found, will serve very well in an emergency as a substitute rubber rim on the wheels. The rubber band should be cut considerably wider than the width of the wheel because it is narrowed a good deal when stretched over the wheel. It will hold by itself, but may be fastened with cement if desired.—LAWRENCE E. LANGHAM.

RACK OVER WORKBENCH KEEPS TOOLS HANDY

THERE are tool racks and tool racks, but here is one that is especially handy because the tools are suspended directly over the bench, where the workman has only to reach up to get the right one. Small hooks are welded to a light metal strap, which is twisted and bent so that it may be fastened to each end of the bench.—JOSEPH C. COYLE.

HOMEMADE OSCILLOSCOPE

(Continued from page 59)

unit and the lamp house are lined up as shown in the illustrations, so that the vertical slit of light reflected by the vibrating mirror shines on the center of the scanning screen. The light beam should then travel parallel to the edge of the baseboard.

The focusing lens, taken from a ten-cent camera and cemented to a sheet-copper mount, is moved back and forth in the path of this beam of light till a sharp image of the slit on the lamp house appears on a piece of paper held against the condensing lens. The focusing lens is then cemented permanently.

When the paper is removed, the vertical slit should be focused directly on the condensing lens, whereupon a point of light will appear on the ground glass back of the lens. Any movement of the vibrating mirror causes a greatly magnified movement of this point.

Details of the sound recorder, which records sound waves on No. 120 roll film, are shown in a drawing and one of the photographs. The two dowels used must be covered with velvet as the sensitive side of the film passes over them. The recording drum was cut from the handle of a discarded broom.

The film replaces the ground glass of the scanning screen and also takes the place of the revolving mirror unit, which should be removed. The ground glass is removed and the scanning screen turned around, but take care that the slit of light is still sharply focused on the condensing lens. The recording unit should be located with ⅛-in. clearance between the condensing lens and the recording drum, before focusing. A focusing screw is added so that the spot of light may be focused accurately on the film.

To facilitate focusing, drill a ⅜-in. hole through the recording drum directly in back of the condensing lens. By threading a piece of discarded film through the recorder, the condensing lens can be slowly moved closer to the film by means of the focusing screw until the spot of light on the film, viewed through the hole in the drum, is as sharply focused on the film as possible.

The actual recording must be done in a photographic darkroom under a red light safe for film. Thread the end of the film through the recorder, after making the recorder light-tight as shown in the photograph. With the recorder connected t the radio, pull the film past the condensing lens quickly and evenly when the sound you wish to record occurs. Then develop the film as usual. Use ordinary film because it is not as sensitive to stray light as the faster types. The oscillograms illustrating speech and the a.-c. hum were made by this method.

PHOTO ACCESSORIES

(Continued from page 80)

lack of a lens hood. The hood illustrated is made from a length of annealed piano wire coiled into a spiral spring, hardened, and then soldered to the outside ring of a filter holder or a band made to fit the lens snugly. It is then covered with rather thick black cloth. The hood may be left permanently in place on the front of the camera as its spring construction permits it to fold up out of the way as the camera front is closed. If you use a filter holder, its usefulness will not be impaired because you can still unscrew the clamping ring and insert the filter glass. The filter glass itself, when not in use, can be carried conveniently in a small chamois

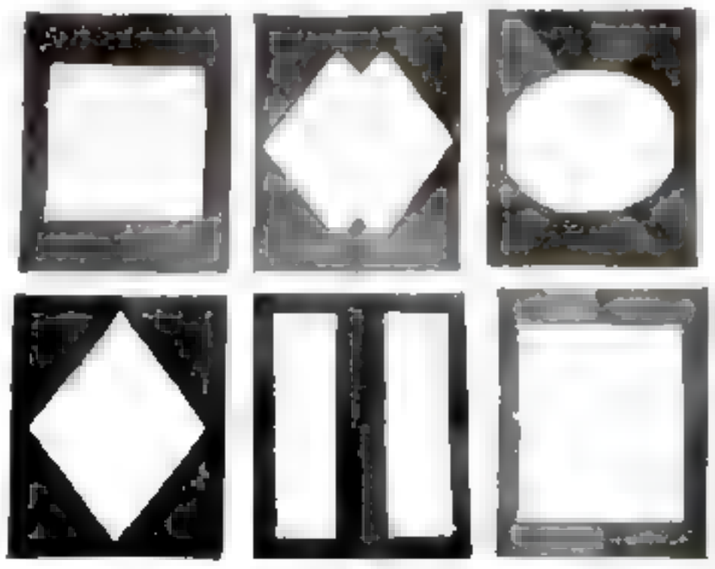
An accurate square or rectangular opening may be cut merely by folding the paper twice

pocket glued to the bed of the camera underneath the bellows.

Even a camera with a ground-glass back cannot produce wire-sharp negatives unless the focus is sharp. In poor light it is difficult to get the focus exactly right. A ten- or fifteen-cent magnifying glass with the handle sawed off and mounted by means of a clock-spring clamp to the hood covering the ground glass will make exact focusing easy even when the light is bad. Anneal the clock spring by heating it in the fire, bend it to the shape shown, and reheat and quench in water to restore the temper.

The semicircular gadget for the enlarger is also a great convenience. It is best made from a piece of heavy tin or light brass. This is pierced with three holes located on an arc that centers on the bolt hole, and each of the holes is of a diameter equal to the diameter of the enlarging lens. The front panel of the enlarger is drilled for a tight fit for a ¼-in. stove bolt.

The first of the three holes is bisected with a piece of very thin metal or heavy paper about 3/16 in. wide. When this opening is placed in front of the lens, it acts as a check on the focus. If the lens is out of absolute focus, a double image is seen on the paper, and only when the lens is adjusted for absolute sharpness does the double image disappear. The center *(Continued on page 92)*



A few of the mask openings that can be cut with perfect uniformity by using a trimmer

PHOTO ACCESSORIES

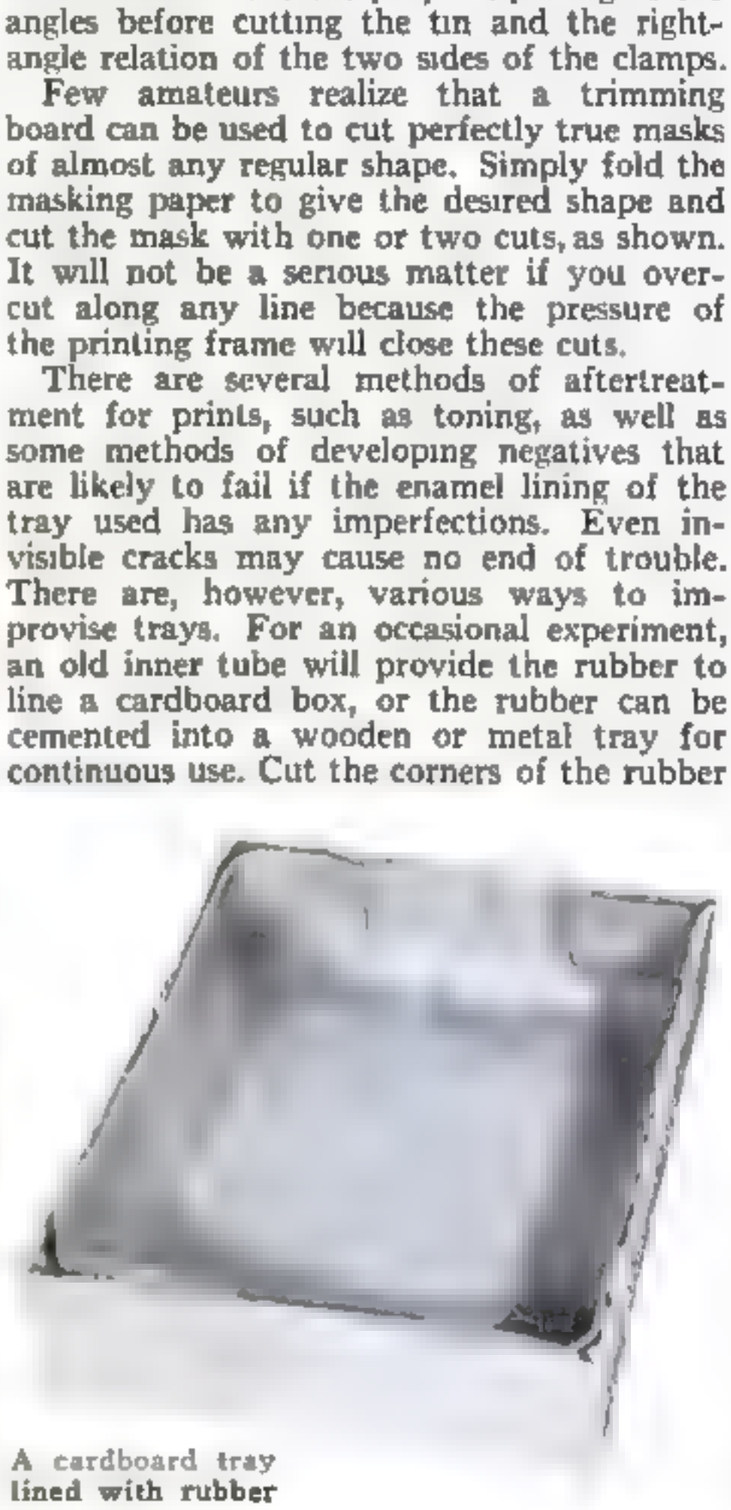
(Continued from page 91)

opening is covered with a piece of red cellulose wrapping material and is used until the sensitive paper is properly arranged. The third opening is left clear for the exposure. A small split washer or a few turns of coil spring placed under the head of the stove bolt will provide sufficient friction to hold the required opening firmly in place.

A foolproof and easily operated border mask can be made by cutting two L-shaped pieces from thin tin such as a worn-out ferrotype plate. The two right angles are then joined by means of two adjustable sliding clamps that enable any size rectangle or square to be framed with the assurance that the sides will always be parallel. The legs of the angles as shown are 1½ in. wide, but they can, of course, be made any width that will suit your purpose. The only precautions to be observed are the proper squaring of the angles before cutting the tin and the right-angle relation of the two sides of the clamps.

Few amateurs realize that a trimming board can be used to cut perfectly true masks of almost any regular shape. Simply fold the masking paper to give the desired shape and cut the mask with one or two cuts, as shown. It will not be a serious matter if you overcut along any line because the pressure of the printing frame will close these cuts.

There are several methods of aftertreatment for prints, such as toning, as well as some methods of developing negatives that are likely to fail if the enamel lining of the tray used has any imperfections. Even invisible cracks may cause no end of trouble. There are, however, various ways to improvise trays. For an occasional experiment, an old inner tube will provide the rubber to line a cardboard box, or the rubber can be cemented into a wooden or metal tray for continuous use. Cut the corners of the rubber



A cardboard tray lined with rubber

so that they will lap and form a long joint, which must be firmly cemented.

Incidentally, there are many uses for an inner tube around the darkroom. Stretched over your developing table and tacked or cemented in place, it makes an indestructible and solutionproof covering. Split and threaded at one end with a piece of tape or cord, it makes a fine waterproof apron.

Ferrotype tins will not stick to the prints if they are washed with a good grade of laundry soap to remove the invisible scum. Use boiling water for this washing, then rinse them with more scalding water. Wash each plate a second time with pure Castile soap and moderately hot water, and rinse with water of the same temperature. Then polish to a high finish with a very soft cloth. They will need no further attention for at least a month if they are used regularly. If you use chromium ferrotype plates, clean them occasionally with a little moist household cleanser of a strictly nonscratching type to remove the scum and watermarks.

STEEL BASE SUPPORTS MODERN STAND

(Continued from page 66)

bend. The long curve of the uprights can be hammered to shape by pounding it on the flatter part of the neck of an anvil. When the curves have been made symmetrical, mark the point for the square turn at the upper end, on which the top slab rests. Prepare the other wrought-iron legs in the same way so that the curves match. Drill the flat portion for three ¼-in. rivets, and drill holes for the screws which fasten the top in place with a 3/16-in. drill. Lay out and drill the base

Now cut the top to size. In the original stand, the top was made of plywood. If narrow strips are glued together, select the wood carefully and see that the annular growth rings are reversed in adjacent pieces. This will reduce the factor of warping.

List of Materials

Top—1 pc. ¾-in. fir plywood 12½ by 20½ in., or birch or maple strips glued together.
Uprights—2 pc. wrought iron or mild steel ¼ by 1 by 42½ in.
Base—1 section of auto frame at least 7 in. wide and 16 in. long, or 1 pc. 7- or 8-in. channel steel 16 in. long, or 1 pc. white pine 1¾ by 7½ by 16 in.
Fastenings—6 roundhead rivets ¾ by ¼ in.; 8 roundhead screws, ⅞-in. No. 10.

Rivet the wrought-iron pieces to the base with the round heads up. Use a rivet set and hammer the rivets on the underside of the base until they hold the wrought-iron pieces firmly. If a wooden base has been used, fasten the wrought iron to the wood with 1½-in. No. 12 roundhead screws. Turn the base assembly upside down on the underside of the top. By careful spotting and measuring, locate the marks for drilling the top for screws. Use a ⅛-in. drill, being cautious so that the drill does not penetrate the top. Fasten the top to the base with the ⅞-in. No. 10 roundhead screws.

Finish the piece with gloss enamels. If the iron and steel parts are the least bit rough, they should be made smooth with a file and emery cloth. Wipe off all filings and dust with gasoline or turpentine. Two contrasting colors should be used, the top of one solid color and the base assembly of another. The top, for example, could be a rich red or brown with black understructure. Two coats are usually necessary to cover thoroughly, with a slight rubbing with fine or worn sandpaper between coats.—H. W. Anderson.

IMPROVISED HOLDER FOR CUT FILMS AND PLATES

Amateur photographers who own a film-pack camera but have no plate holders, can improvise a plate holder or cut-film holder when necessary from an empty film-pack container and a few pieces of cardboard. Take the container apart and bend the springs to make them stronger. Go into your darkroom, lay the plate or cut film inside the front part of the container, emulsion side down, and place sufficient cardboard fillers on the plate, before laying in the black shield and springs. Now reassemble the container, put it in the film-pack adapter in the customary way, and close the latter.—Robert Young.

PLAIN HYPO SOLUTION CLEANS TARNISHED SILVERWARE

Ordinary photographers' hypo solution, if made up without acid, is excellent for cleaning tarnished silver without wearing away the surfaces as abrasive polishes are likely to do unless cautiously applied.—E. V. B.

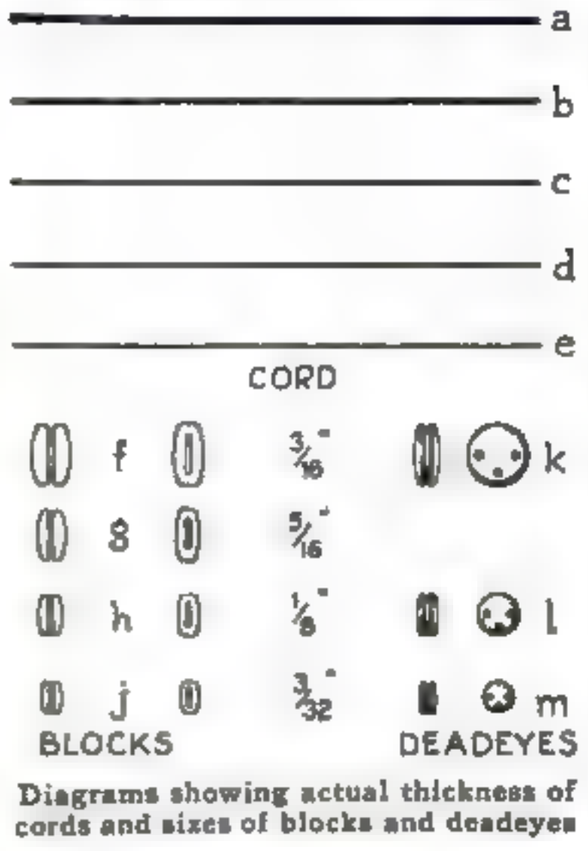
SPARS FOR THE *GREAT REPUBLIC* MODEL

(Continued from page 74)

called the dolphin striker, tapers from the middle to the ends. It has an eye above to engage that in the cap, and cleats for the stays. The latter are made of flattened wire, pushed through and bent down. The arrowhead at the end is a piece of brass. It is well to bind the ends of this and the spanker boom and gaffs with fine wire to prevent splitting.

The spreaders for the jib-boom guys are of similar shape, but thinner. They hook to bolts in the sides of the cap, and each has two little wire eyes for the guys to reeve through.

The three upper yards need spider bands at the yardarms, with eyes above and abaft, except at the mizzen where they are above and before. The yards below also have eyes underneath. I made these of twisted wire.



Diagrams showing actual thickness of cords and sizes of blocks and deadeyes

All the yards require jackstays. I made the bolts for these of tiny wire staples, through which I rove straight wires. The yards also need bolts amidships for the halyards, and they have to be fitted with footropes. The jackstays and footropes are all of the same size material, but other parts must be in proportion to the size of the yards.

My practice is to make footropes and stirrups of black, silk-covered magnet wire, No. 32, because cord will not hang in position. A stirrup is made by twisting the wire around another piece of wire to form an eye; next measure and bend the other end, slip it under the jackstay, and give it a twist. Then reeve the footrope through and twist the ends to the lower eyebolts or jackstay, as shown. The length of the stirrups will vary from ½ in. on the lower yards to 5/16 in. on the skysail, hanging the footropes ¼ in. below the center of their yards. The footropes of the larger yards are divided and cross, but on the smaller yards are continuous from end to end.

The skysail, royal, and topgallant yards have wooden saddles bolted to them, with strip-metal parrels to go around the masts. The latter are nailed to the saddles with pinheads.

The upper topsail yard has to extend from the mast so that its sail will set right, so I gave it a truss like that for a lower yard, but smaller and with a parrel abaft. This parrel I made of metal strip, pinching a lug on one side, soldering it to the truss, and leaving long lugs on the other side, to be soldered together when I put it in position around the mast.

For the lower-yard trusses I bent to shape a piece of No. 18 copper wire, hammered it flat vertically in the middle and horizontally at the ends; these ends I then soldered between the ends of bands to fit around the yards. It should be made to allow the yard to turn horizontally and vertically, but I just drilled it in the middle and nailed it to the mast with a No. 20 escutcheon pin, with a little brass sleeve between truss and mast.

The lower topsail yards need iron sheaves amidships for the chain ties. These I made from a dumb-bell-shaped piece of brass and a brass disk (see drawing of the yard). The pin is soldered in position after nailing the shell of the block to the yard.

Under the lower topsail and lower yards I put the blocks for the chain topsail sheets, as these are permanent fittings. They are made like those just described, but wooden sheaves cemented in will serve.

Before putting anything else on the yards, I gave them bands like those on the masts, where the halyard bolts and topsail sheet blocks go.

The actual rigging of the ship will be taken up in the next article of this series.

KEY TO RIGGING PLANS

To save space the following abbreviations are used:

F	fore	P	port	TM	topmast
hal	halyards	R	royal	TS	topsail
L	lower	S	starboard	TG	topgallant
M	main	Sp	spanker	U	upper
Mz	mizzen	T	top		

The parts are numbered as nearly as possible in the order of application to the model. The letters below a part are details to be applied to that part before installation. The sizes of cords and blocks are indicated by small letters following the name of the part. Cord *a* is equivalent to No. 20 (B. & S.) gauge wire; *b* to No. 24 wire; *c* to No. 30; *d* to No. 34; *e* to No. 70 sewing cotton. Blocks *j* are 3/16 in.; *g*, 5/32 in.; *h*, ⅛ in.; *j*, 3/32 in. Deadeyes *k* are 3/16 in.; *l*, ⅛ in.; *m*, 3/32 in.

(Continued on page 95)

N° OF PART	DIAM	LENGTH
★ 1	◯	3"
★ 2 - 3	◯	9"
★ 4	◯	8 5/16"
★ 121	◯	7"
22 - 27	◯	7 1/16"
31	◯	6½"
124	◯	5 9/16"
45	◯	7"
53	◯	5⅝"

Full-size diameters and lengths of all spars. The lengths of the masts marked with an asterisk (*) are how far they project from hull

N° OF PART	DIAM	LENGTH
105	◯	10 9/16"
117	◯	11¼"
101 - 144	◯	8⅜"
113	◯	8⅝"
97-109-140	○	⅞"
81-93-136	○	5¾"
69-77-89	○	4¾"
65-73-85	○	3¾"
61	○	2¾"
17	◯	8 3/16"
129	○	3⅞"
132	○	3 5/16"
135	○	1⅝"

KEY TO RIGGING PLANS

(Continued from page 94)

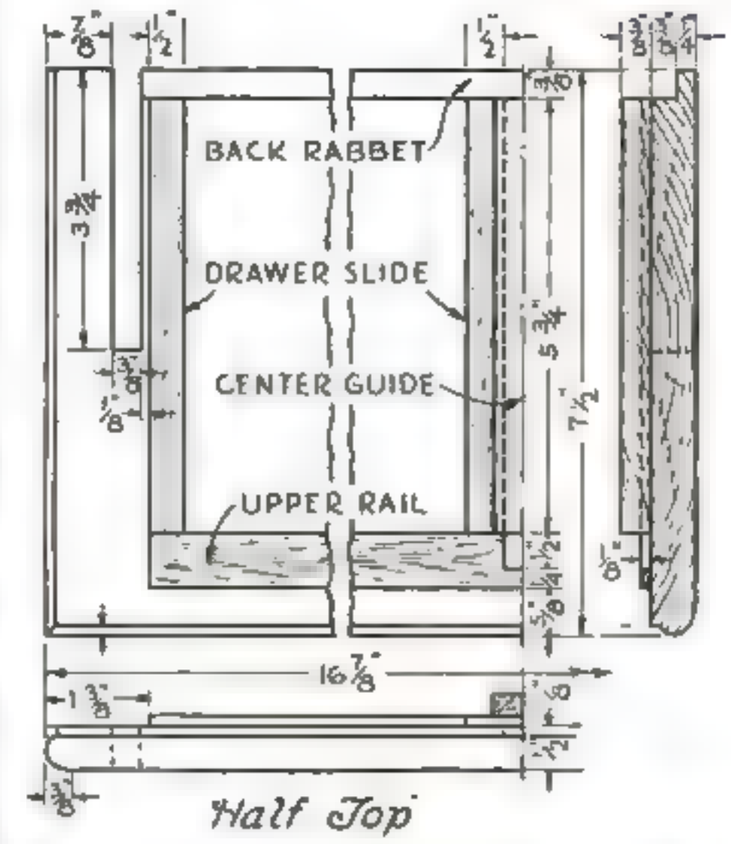
1 Bowsprit
a jib-boom cleat
b cap
c bees (P & S)
d bobstays (hearts)
e bowsprit shrouds (hearts)
f gammoning
g handropes and staysail net
2 Fore lowermast
h bands
i paunch
j belaying-pin band
k futtock band
m truss band
n cleat and bolt for TS hal
o top
p futtock shrouds
q cap
z cheeks (P & S)
3 Mainmast (parts as for 2)
4 Mizzenmast (parts as for 2)
5 F stay a
6 M stay a
7 Mz stay a
8 F shrouds a
9 M shrouds a
10 Mz shrouds b
11-13-15 Cap stays a
12-14-16 Cap backstays a
17 Jib boom
r boom footropes
17a Spreaders
18 Martingale boom
19 Martingales
20 Backropes (P & S)
21 Boom guys b
22 Fore-topmast
s crosstrees
q cap
23 FTM shrouds bl
24 FTM backstays ak
25 FTM stay a
26 Inner jib stay a
27 Main topmast (parts as for 22)
28 MTM shrouds bl
29 MTM backstays ak
30 MTM stay a
31 Mizzen topmast (parts as for 22)
32 MzTM shrouds bl
33 MzTM backstays ak
34 MzTM stay a
35 Fore TGR skysail
36-37 FTG stays b
38 FTG shrouds b
39 FTG backstays bl
40 F. R. stay c
41 FR backstay cm
42 Skysail stay d
43 Skysail backstays d
44 Jacob's ladder (at FMMz masts)
45 Main topgallant mast
46 MTG stay b
47 MTG shrouds b
48 MTG backstays bl
49 MR stay c
50 MR backstays cm
51 Skysail stay d
52 Skysail backstays d
53 Mizzen topgallant mast
54 MzTG stay b
55 MzTG shrouds b
56 MzTG backstays bl
57 MzR stay c
58 MzR backstays cm
59 Mz skysail stay d
60 Mz skysail backstays d
61 Mz skysail yard
All yards have following parts
u parrels
v jackstays
w footropes
x eyebands
62 Mz skysail lift d
63 Mz skysail hal dh
64 Mz skysail braces ej
65 Mz royal yard
66 Mz royal lift d
67 Mz royal hal ceh
68 Mz royal braces ej
69 MzTG yard
70 MzTG lift c
71 MzTG hal cdh
72 MzTG braces ef
73 Main skysail yard
74 M skysail lift d
75 Main skysail hal deh
76 Main skysail braces ej
77 Main royal yard
78 Main royal lift d
79 Main royal hal cdh
80 M royal braces dj
81 MTG yard
82 MTG lift c
83 MTG hal cdg
84 MTG braces dh
85 Fore-skysail yard
86 Fore-skysail lift d
87 Fore-skysail hal dch
88 Fore-skysail braces ej
89 FR yard
90 FR lift d
91 FR hal cdh
92 FR braces dj
93 FTG yard
94 FTG lift e
95 FTG hal cdg
96 FTG braces dh
97 FUTS yard
98 FUTS lift b
99 FUTS hal acf
100 FUTS braces dg
101 FLTS yard
102 FLTS lift b
103 FLTS hal cf
104 FLTS braces dg
105 Foreyard
106 Foreyard slings
107 Foreyard lifts dh
108 Foreyard braces cf
109 Main UTS yard
110 Main UTS lift b
111 Main UTS hal acf
112 MUTS braces dg
113 Main LTS yard
114 Main LTS lifts b
115 Main LTS hal cf
116 MLTS braces dg
117 Main yard
118 Main yard slings
119 Main yard lifts dh
120 M yard braces cf
121 Spanker mast
122 Spanker mast shrouds bl
123 Spanker mast stay b
124 Sp topmast
125 SpTM stay b
126 SpTM backstay cm
127 SpTGM stay d
128 SpTGM backstay dm
129 Sp boom
130 Sp boom topping lift ch
131 Sp boom sheet bg
132 Sp gaff
133 Sp gaff span
134 Sp gaff vangs eh
135 SpU gaff
136 MzUTS yard
137 MzUTS lifts c
138 MzUTS hal bdg
139 MzUTS braces dg
140 MzLTS yard
141 MzLTS lifts c
142 MzLTS hal dg
143 MzLTS braces dg
144 Mz yard
145 Mz yard slings
146 Mz yard lifts dh
147 Mz yard braces dh
148 U gaff span d
149 U gaff vangs d

Note: Offside halyards not shown abaft masts.

Snapshot of W. G. Simmons and wife, Miami, Fla.

PLANS FOR A DAINTY DRESSING MIRROR

(Continued from page 62)

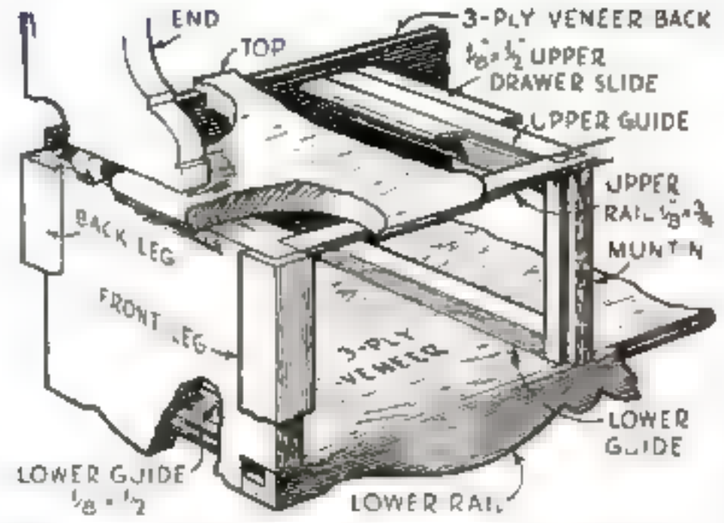


Half Top

Upper Guide

Lower Guide

Muntin



Perspective showing method of construction. The other drawings give dimensions of parts

against the ends of the four, guiding on the line parallel to the front edge, and notch out, as detailed, to fit the space between the center strips.

Rabbet a piece ¾ by ¾-in. stock 5¾ in. long as shown for the upper guide, and nail and glue it between the center slides on the top to serve as a center guide for the drawers. Saw notches in the top 3¾ in. long (measured from the back edge) between lines squared ⅞ and 1¼ in. respectively from the ends, as shown in the top detail. This finishes the top.

The muntin is like the upper center guide except that the rabbets are ¼ in. deep, and a tenon ⅛ in. long and ½ in. thick, rising between the rabbets, is made on one end to fit into the notch of the upper rail, already glued to the underside of the top. The total length is 4½ in.

For the lower rail, make a half-pattern on a 1½ by 8-in. strip of cardboard ruled with ½-in. squares, giving the piece a total length of 1 ft. 3⅝ in. Before shaping the lower edge, rabbet the upper edge ⅜ by ½ in.

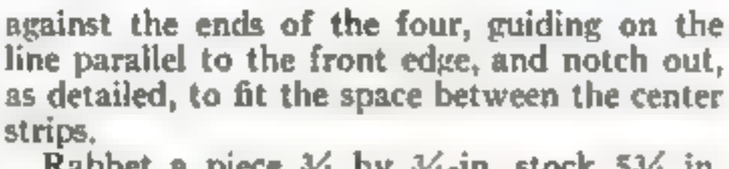
Make the bottom of ⅜-in. three-ply panel veneer, 6¼ in. by 1 ft. 2⅝ in., and the back, 5½ in. by 1 ft. 2⅞ in.

Assemble the ends and bottom with glue. Slide the top into place in the end dadoes, and toenail 1-in. brads into the underside through the end pieces, where the legs will cover the heads. Put the muntin in place, springing the bottom down sufficiently to clear the tenon, and nail the lower end through the bottom. Then add the lower rail, gluing all joints and nailing the front edge of the bottom into its rail rabbet with ¾-in. brads. Put a ½ by ¼-in. lower center guide on the bottom, applying it as shown in the broken-away perspective drawing of the case.

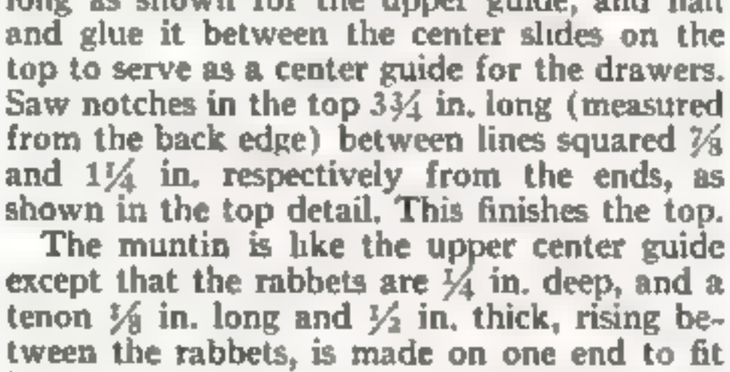
The two front legs are made of stock 1½ in. square and 7¼ in. long. For a length of 5¼ in., rabbet each ¼ by ¾ in.; then lay out and cut the curved parts from a pattern made on a piece of cardboard with squares. The side pattern, when bent around the shaped curve, gives a true profile for cutting the other sides. Carve out the curved surfaces until they blend smoothly into the straight parts, round off the two rabbet corners as shown, and glue the legs to the box.

The back legs are profiled in only one direction, the front faces being curved back to give the necessary thinness. The back face of each is rabbeted ½ by ¾ by 5¼ in. to fit over the back edge of the end pieces, and has a ⅜ by ⅜-in. rabbet to receive the end of the back.

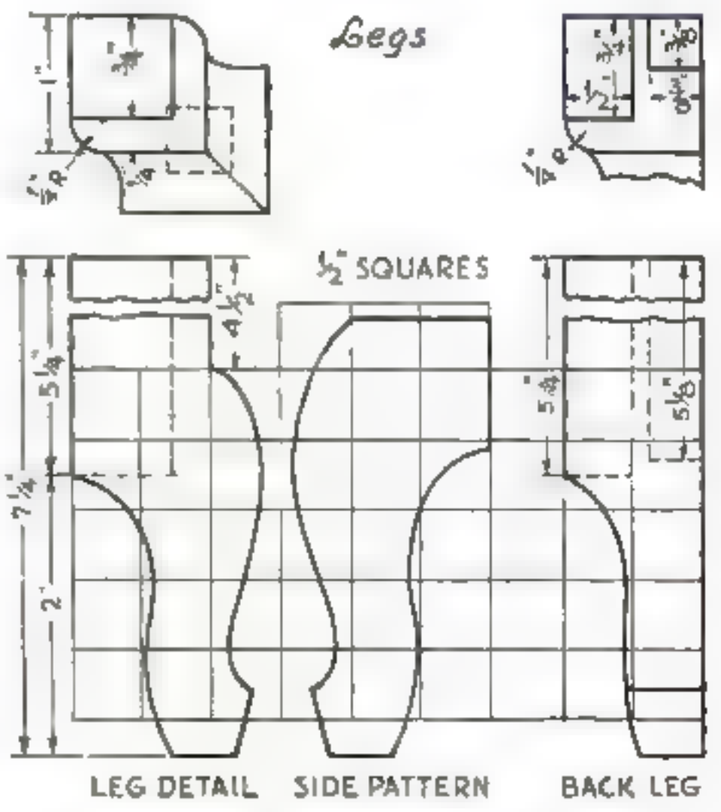
For the upper mirror rail, cut a piece of 1 by 3 by 16-in. stock and make a mortise ¼ by ¾ by ¾ in., centering on the face edge and 6 in. from a center line squared across the face side. Between the two mortises, rabbet the edge ½ in. wide and ¼ in. deep. Make a half-pattern and *(Continued on page 97)*



Half Lower Rail

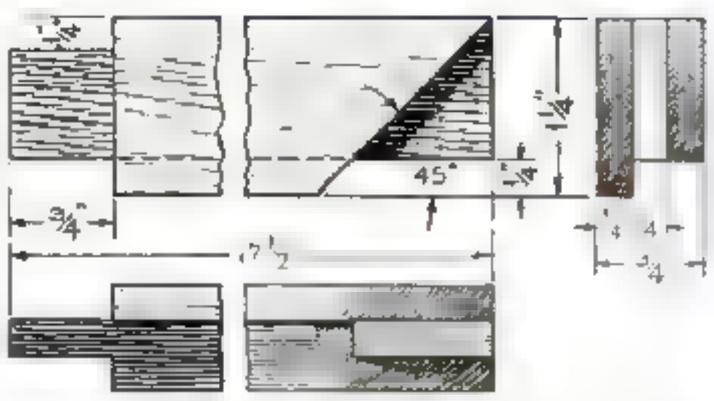


Half Upper Mirror Rail

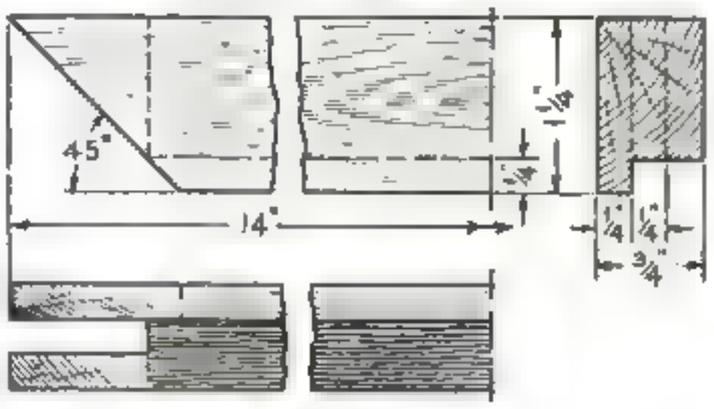


A DRESSING MIRROR

(Continued from page 96)



Mirror Stile
(MAKE TWO)



Half Lower Rail

shape the upper edge in the way shown.

The lower rail is ¾ by 1¼ in. by 1 ft. 2 in., rabbeted full length on one edge. Miter both ends as shown, and notch them ¼ in. wide and 1 in. deep, to receive the tenons on the stiles.

The stiles are made in much the same way, except that the upper ends have ¼ by ¾ by ¾-in. tenons centered on the stock, and the lower ends, which are mitered, have triangular tenons that mate with the lower rail. The total length is 1 ft. 5½ in.

After trying the parts to see that they fit, assemble the rails and stiles and reënforce the joints by driving brads into them from the backs. Round off the inner corners of the frame to a radius of ¼ in. Slip the mirror into the rabbet from behind, cover the back with cardboard, and secure it with a ¼ by ¼-in. molding nailed inside the rabbet. Hang the mirror on the end supports with pivots screwed to the back.

Make the drawers carefully to fit. The front should be made of ½-in. stock, and it will be about 4⅜ by 6 13/16 in. It is rabbeted 13/32 by 5/16 in. at each end to take the ¼-in. thick sides and leave the necessary overhang. It is also grooved ¼ by ¼ in. inside at a distance of ¼ in. from the lower edge to take the bottom. The sides are ¼ by 4⅜ by 6 3/16 in., grooved ¼ by ⅛ in. for the bottom and rabbeted on the back ends ⅛ by ¼ in. for the back. The back is ¼ by 4 by 6¼ in., and the bottom ¼ by 6¼ by 6⅛ in. Verify all dimensions from the assembled cabinet.

In assembling the drawers, nail the sides to the front rabbets with 1-in. brads, and the back to the side rabbets with ¾-in. brads. Slip the bottoms into the grooves, square up, and nail the bottoms. So made, the drawers should have a side and a back clearance of about 1/16 in.

To correspond with the stops on the muntin, glue ⅛ by ½-in. stops against the end pieces of the cabinet, and glue similar pieces horizontally as side guides, both at top and bottom. Slip the drawers in place, note the fit of the fronts, and make necessary corrections. By working accurately and beveling slightly the edges and ends of the front, the joint can be made very narrow without the drawer's binding. Note that the fronts slide 1/16 in. behind the rail and muntin faces.

Sandpaper the wood to glasslike smoothness, finish as desired, line the drawers with velvet, and put on the drawer pulls.

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SAFE STEERING DEVICE FOR BOBSLED

THE steering apparatus is the most important part of any bobsled and only too often it is inexpertly made, thereby endangering the safety of the crew. A practically perfect steering mechanism, however, can be constructed from the steering wheel of a model-T Ford with a minimum of expense and trouble.

Measure the distance from the deck of the bob to the underside of the front sled and add the desired height above deck. The total

Front end of bob. The deck plate is in two pieces, but one solid block is really better

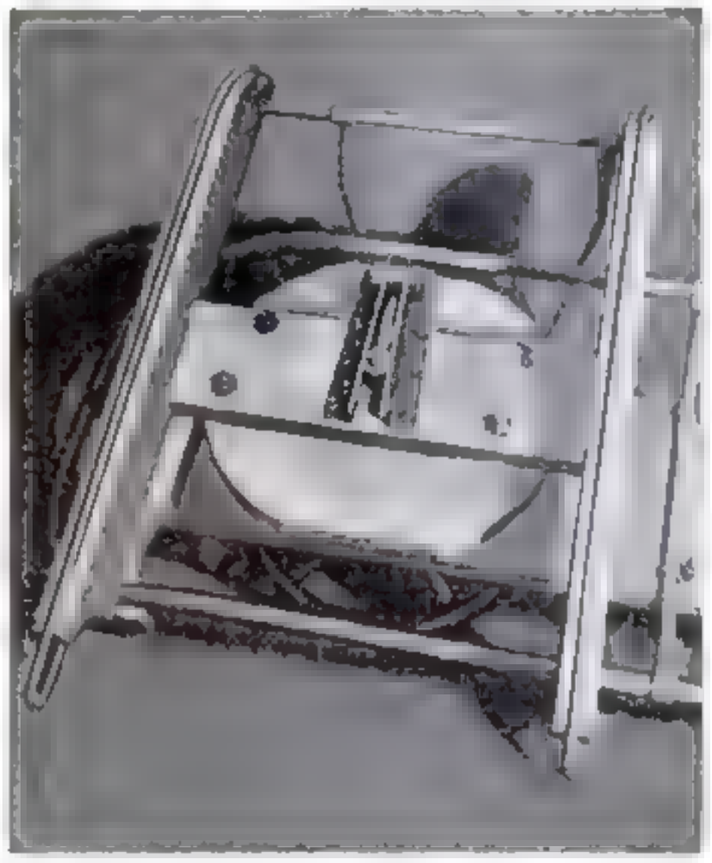
should not be over 16 or 18 in., as a bob which hugs the road is less likely to upset. The shaft will have to reach through this distance when the wheel is attached, and another 2 to 2¼ in. will have to be added to hold the crank and nut. Cut the shaft at the indicated length and take it to a machine shop to be retapered, threaded, a new key slot cut, and a hole drilled for a cotter pin to hold the castellated nut permanently in place. The expense of this work will be slight.

The crank is a drop forging and can be bent, when red hot, to the shape indicated.

Only 2 or 3 in. of the steering column project above deck, but enough of the column should be left to permit tabs 1½ in. long to be turned back for fastening beneath the deck block. Make the deck block of hardwood about 1 in. thick and of generous outside dimensions, recessing the undersurface to take the tabs and cutting a hole for the steering column to pass through. Slide the column in place, bend back the tabs, drill and countersink them, and screw firmly into the recesses provided. Bolt the deck block to the deck, countersinking the nuts in the underside of the deck. The hole through the deck for the steering shaft should not fit too closely. Neither should the hole running down through the lifts which give the bob necessary height, these lifts being bolted securely to the deck.

The lower lift and the opposed part of the sled are faced with pieces of sheet steel or iron, held in place with carefully countersunk screws. Facings of galvanized iron will suffice if renewed occasionally.

Run the shaft through the hole in the sled, set the key, drive home the crank, tighten the nut, and place the cotter pin. With 3/16-in. bolts, five to a side, fasten pieces of 1½-in. angle iron about 6 in. long to the underside of the sled, one each side of the crank and snugly against it, holding it in a fore-and-aft position. Over the end of the crank, bolt a strap of 1½ by ⅛-in. cold-rolled steel.

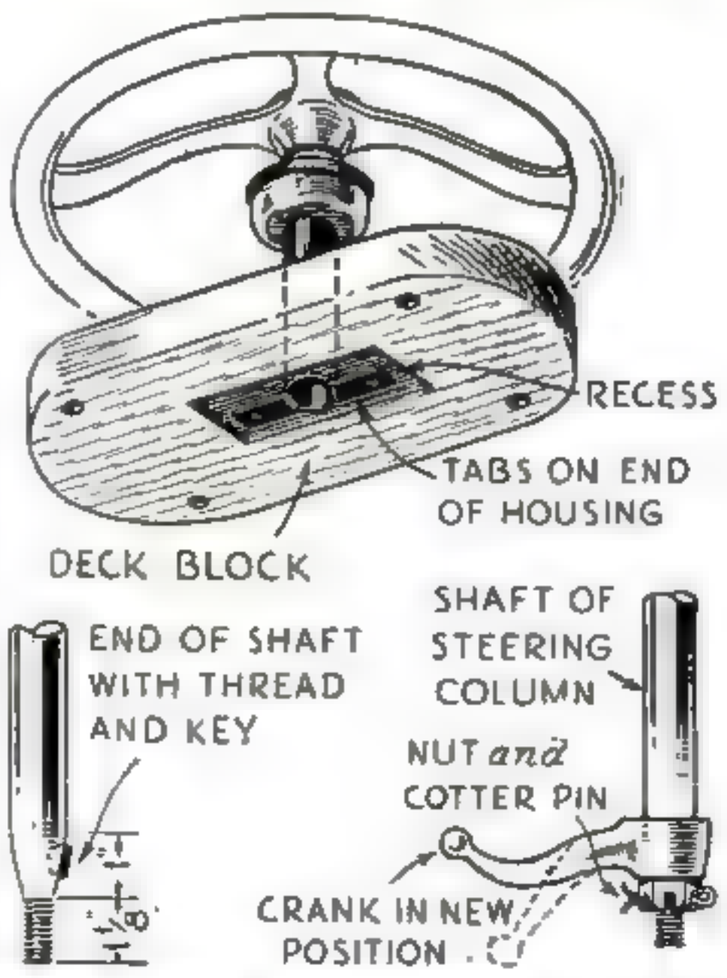


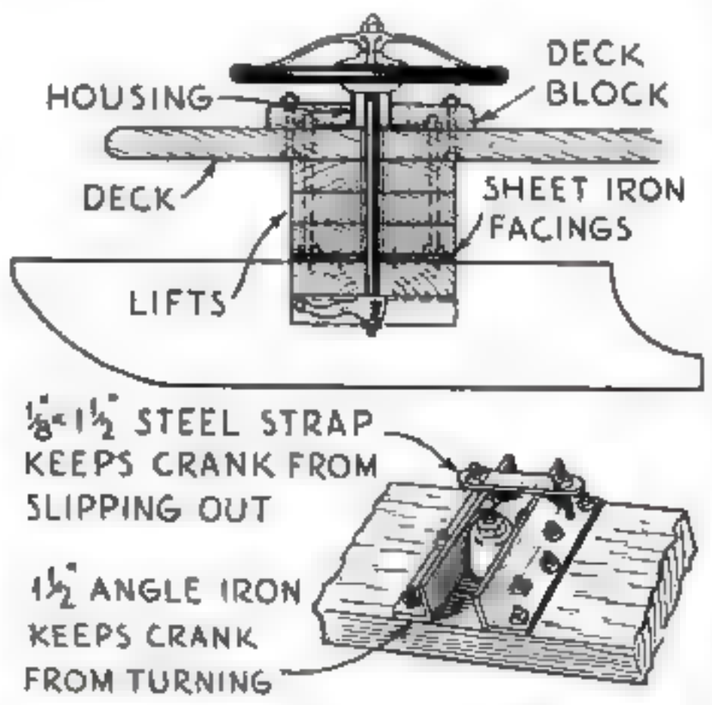
Underside showing crank gripped between the L's and the strap for holding it in position

Peen the ends of all bolts to prevent loosening.

This arrangement proves its worth on a twisting hill because the gearing within the shaft head is almost three to one, making steering an easy matter. To facilitate matters further, the shaft should be placed about 2 in. forward of the center of the bearing of the front sled, thus creating a tendency to hold a straight course and to return to a straight course when pressure on the wheel is relieved. Sufficient play is allowed in the sled to accommodate any but the roughest ground, and still a firm connection is assured. Play in the wheel itself can be eliminated only by putting in new gear wheels, something which should be done at once if the wheel can be moved more than an inch without turning the sled.—JACK HAZZARD.

Instructions for making a bobsled to which this type of steering mechanism could easily be fitted were published in a previous issue (P. S. M., Feb. '35, p. 67).





POCKETKNIFE SCOTTIES IN SIX VARIATIONS

(Continued from page 63)

the bottom line of the chin, will help define the throat, and a series of parallel V's along Mac's lower jaw give him his whiskers. Now put a V or two toward the center of Mac's side, as indicated, and a notch or two where his toes are hidden by hair, and he's about ready. These V's all help to do one thing—to break up any remaining plane surfaces and to give the pup's coat a rough appearance.

Mac's eyes are set just below the ridge of his nose. You can simulate them by cutting in small but deep pyramidal notches, but I've found it better to use instead the little shiny black roundheaded pins women use for veils or corsages. (You can get the pins at the ten-cent store or use a black bead with a straight pin through it.) The pin end is cut off up to within about ¼ in. of the head, then pushed into a hole drilled for it. This gives Mac's eyes the necessary sparkle.

YOU'LL probably want to paint Mac black—he'll look more realistic that way. India ink or black water color is suitable because it gives a very dull finish.

Mac's sidekicks are made just as he is. The same head design is used in each case, but is placed in a little different position. You can make a dozen or two more poses simply by studying your own dog—I would have myself, but I ran out of Scotch names for them. If you want Mac's head cocked on one side as he would so often cock it if he were alive, take a thicker block. Mark out on it Mac's body and cut that out, then form a ¾ by 1 by 1¼-in. block on the neck with the long dimension in the direction in which you want Mac's nose to point. On the side of this block, draw your checkerboard and Mac's head, as in Fig. 4. Whittle him out, and there you are!

The ball that Jock is playing with can be cut out of the same block or can be a small bead glued in place. You'll have to watch Lad's legs so that you get the correct stepping motion. Hollow his right feet to half depth. Tam will probably have to be glued to some sort of base to keep his hind legs in the air, unless you drill and weight his fore-legs. Sandy is, of course, drawn on his stomach in Fig. 1 so that the grain goes in the proper direction; you'll have to set him up after he's finished.

THESE little Scotties have dozens of uses besides just decorating the mantel, coffee table, or dresser. You can use them to top cigarette boxes, on ash trays, to decorate ink-stands, book ends, picture frames, and so on. If the size isn't exactly right, simply take a block of the size you want to use and lay out on it a checkerboard with as many squares as required by the particular pattern you plan to use. If each square is ½ in. in size, your dog will be twice as big; if ⅛ in., half as big. You can also make the Scotties in mahogany or walnut for special jobs.

If you'd prefer other breeds of dogs, get the silhouette from a photograph or drawing and copy it on a checkerboard. That's your base pattern, and slight rearrangements of head and legs will give you endless other poses. And if you want to change from dogs to people, try Skipper Sam'l (P.S.M., July '35, p. 63) or Mère Marthe (P.S.M., Dec. '35, p. 68), both of which are simple figures to whittle.

HINGES FOR MOUNTING PHOTOS

SNAPSHOTS that have notations or data of any kind written on the back can be mounted for convenient reference in an album by means of flexible hinges made of adhesive tape. Black the back of the hinges with ink.—K. M.

FLYING BALL—A NEW, EASILY MADE GAME

(Continued from page 57)

one wood screw so that the mechanism can be moved or swung as necessary for the various shots. The ¼-in. hole in the side limits the travel and prevents the overanxious player from aiming at a point beyond the target

About midway in the bottom of the box, place the hurdle that the ball must strike and leap before it can reach the pockets. The hurdle is made from a 1-in. square block about 5 in. long. Plane a 45-deg. bevel on the block. The exact location of this hurdle with relation to the pockets should be determined after a few experimental shots at the targets, because the size of the spring used and the diameter or weight of the balls will influence its position. It should be placed so that the full force of the spring will easily carry the balls to the highest pockets.

The wire for the net at the top of the game can also be obtained from a coat hanger. This frame is not at all essential to the game, but occasionally while shooting at the highest pockets the ball will carom off the panel and into the room. The net will keep the balls in the game at all times. Many articles have been published in this magazine describing various methods of weaving and tying cord, any one of which may be employed. The net is made as wide as the game and 3 in. high. Its two legs go into two holes drilled in the top of the game.

A wire brace is provided to hold the cover upright. When you make the holes for this brace, be careful to drill into the edge of the panel so that the wire will not obstruct the passage of the ball.

Each player gets three chances at the target for each turn, and an extra turn for each ball placed in the pockets counting ten or fifteen.

WORLD'S GREATEST DAM MAKES ELECTRIC EDEN

(Continued from page 13)

below the dam, and a "bucket" to divert the flow from the bed rock.

Working against time, so as to be able to "put the squeeze" on the river for the greatest possible number of days during low water this winter, thirty steam hammers hurled themselves into the fray to build the west cofferdam, and 1,500 men toiled night and day for three and a half months. In this period, as much material was put into the temporary bulwark as went into the entire Wilson Dam at Muscle Shoals, Ala.—450,000 cubic yards of concrete and 250,000 cubic yards of dirt.

On opposite banks of the river rose Mason City, the all-electric model town housing the workers, and "engineers' town," with its spacious administrative buildings, near the foot of the Government railroad grade.

MASON CITY, intended to be a temporary town, is built of assembled houses, every one of which is heated and serviced completely by electric current supplied by the contractors for three tenths of a cent—a kilowatt hour. Bills for complete heating, cooking, and other uses ran about eight dollars a month last winter.

The town is being used as a huge experimental field laboratory for testing out electrical service for domestic use. Under supervision of scientists from the State College of Washington it is now, for the second winter, being made the scene of experiments in off-peak storage of electrically generated heat for use during the twenty four hours of the day.

Except in the very largest buildings, such as the hospital, department store, and recreation hall, there is no provision for any but electrical heating in Mason City. Long before the dam is completed, the Columbia Basin Commission expects to prove that the ultimate settlers in this great, reclaimed region cannot do otherwise than use electricity for every task to which it can be applied. Feed grinders, machine shops, and every domestic appliance will be serviced, and it is planned to price this power at less than a cent a kilowatt hour.

Admittedly, experiments in adapting off-peak loads for heat storage are still in their infancy. The State College of Washington experts last winter devised a storage oven, filled with bowlders and insulated with mineral wool, with suitable dead-air spaces. Into these they "shot the juice" until a working temperature of from 500 to 600 degrees was found to be about right for providing a steady, comfortable temperature in winter.

All of this apparatus, including the heat-storage oven in the basement of a selected home, a complete conduit system, and thermostatic controls, is being refined and partly redesigned this winter, as complicated instruments register the relations between current input, cost, thermal output, air conditioning, and the scores of other factors that must be considered in making leashed "lightning" serve faithfully the home of tomorrow.

THE oven consists of a four-inch interior wall of brick laid up with mortar, outside of which, at a distance of three inches, is a four-inch wall of hollow tile. The space between is filled with insulating material. Diatomaceous earth mixed with Portland cement and water to give a solid heat insulation, is employed to reduce heat loss through the floor. Bowlders used in filling the oven, range in weight from three to sixty pounds.

Man is turning back the Columbia 300,000 years, into that ancient bed where it fretted for an age or two while a glacial dam held it away from the old "Big Bend." From the Big Bend to which the river returned, he is patiently swerving its course once more, to serve him and his children for ages to come.

ILLUMINATED DIAL FOR WEATHER VANE

(Continued from page 75)

cut from a piece of 1/64-in. brass, 13 in. in diameter.

Lay out on a sheet of paper the inside dimensions of the box and outlines of the partitions. Following the drawing of the dial, mark the position of the letters so they are well inside the partition lines, and describe a circle 13 in. in diameter. Cut out the circular piece of paper and lay it on the brass. With a pencil or prick punch, mark through all the intersecting points of the important lines so that when the paper is removed, lines can be drawn connecting the points, thus giving the outlines on the brass.

Draw the letters carefully on paper, transfer to light cardboard, and cut out. You may design your own or follow the style illustrated. Place these in their proper positions on the dial face and trace around them with a sharp instrument, as pencil marks rub off too easily.

The cable enters through a hole in middle of base, and the wires fan out to the lamps

Cutting out the letters is best done with a jeweler's saw blade in a large U-frame. Insert the blade with the teeth down. Drill a hole in one end of the letters for starting the saw, but be careful the hole doesn't exceed the width of the finished letter. Place the brass face over the edge of a bench or table and saw with a continuous jig-saw motion, moving the brass rather than the saw. A drop of oil occasionally is a great help in cutting. When through sawing, file the edges of the letters smooth.

To finish the center of the face, cut out an eight-pointed aluminum star of about the size shown and also a *fleur-de-lis*, both similar to those found on compass cards. Paint half of each point of the star and *fleur-de-lis* black, giving the effect of depth. Glue these to the center of the face with a metal cement, or rivet or bolt them on, if you prefer.

The rim of the ship's wheel is cut from a piece of ⅜-in. plywood, 10½-in. inside and 13¾-in. outside diameter. Round all the edges and sandpaper.

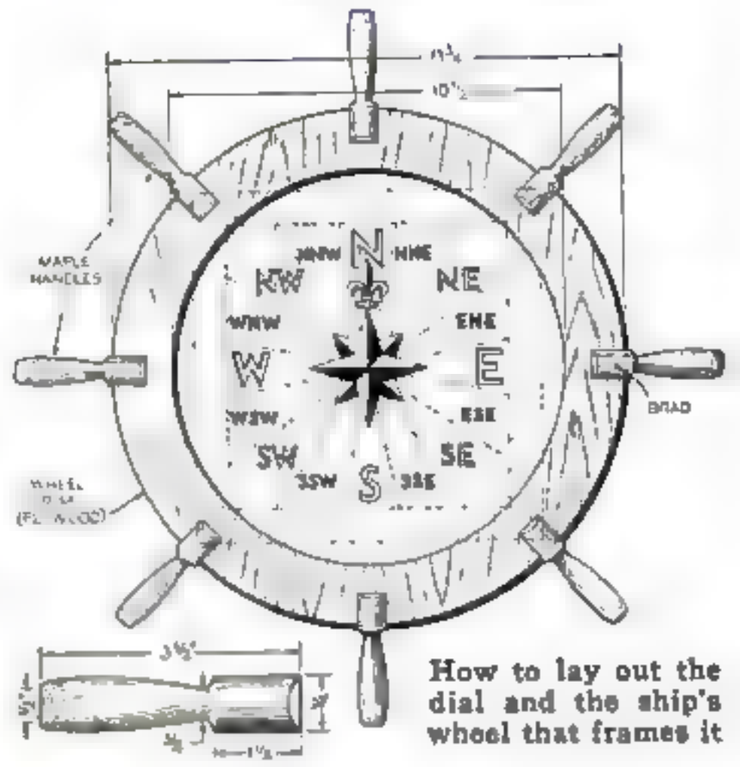
Turn the eight maple handles on a lathe to the correct size and mortise them to fit the rim. Glue them on evenly spaced, using one brad in each to hold them until the glue dries. Oil or stain the rim, handles, and box, as you prefer. Screw the dial face to the back of the wooden rim with eight ½-in. No. 4 brass screws in such a way that the large letters of the dial face correspond with the eight wooden handles.

Since it is not pleasing to have the light shine directly through the letters, paste two or more thicknesses of *(Continued on page 102)*

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

ILLUMINATED DIAL FOR WEATHER VANE

(Continued from page 101)



How to lay out the dial and the ship's wheel that frames it

white or colored tissue paper over the backs of the letters. An attractive and appropriate effect worked out on the author's dial is as follows: North, white; east, light blue; south, light orange; west, brilliant red; northeast, southeast, southwest, and northwest, bright green; and the eight other small points, yellow.

Complete your instrument by screwing the dial face on the box with four ½-in. No. 4 roundhead brass screws, after carefully centering it. The dial face may be kept polished or allowed to tarnish and assume a bronze appearance.

The vane should be taken down at least once a year, the bearing cleaned and greased, the segment table and arm of switch filed clean, any cracks or holes soldered, and the whole assembly painted and remounted. Mounting is greatly facilitated by a rope and pulley hung on a hook screwed to the peak of the roof.

REALISTIC SMOKE FOR MODEL LOCOMOTIVES

MODEL railroad engines have progressed to the point where they have electric lights, "chuggers," and even sparks, but the most needed bit of realism of all has been neglected. That is a wisp of smoke coming from the stack.

Smoke is easy to make and quite safe. Bend to shape two shallow lead cups from lead foil, each one half the size of the inside of the smokestack on the engine. Bind them together with wire and fasten them inside the stack so that they will be just flush with the top. With an eye dropper, place a few drops of muriatic acid in one cup, and the same amount of strong ammonia in the other. Immediately white clouds will pour from the stack and continue for some time, until the chemicals are exhausted.

If you are fearful that the acid may spill and run down inside the stack, it is a simple matter to fit a glass tube or a lead-foil lining to catch any accidental overflow.—W. K.

EPSOM SALTS GIVE UNUSUAL FINISH TO GLASS VASES

GLASS vases for holding artificial flowers can be given an attractive and unusual appearance by painting the insides with a strong solution of epsom salts.—O. B.

• • •

To CONVERT a blueprint into a black-and-white drawing, draw over the white parts with India ink and bleach out the blue ground with a solution of washing soda.—G. S. G.

AVERAGE HOME WORKSHOP OWNER NOW REVEALED

(Continued from page 60)

lows: wood lathes, circular saws, jig saws, tool grinders, polishing heads, drill presses, sanders, jointers, band saws, shapers, routers, portable electric drills, mortisers, and metal lathes.

The list of hand tools contains seventy-two separate items. Most of the shops have an assortment of the more familiar tools, but there are also a large number of machinist's tools, sets of wood-carving tools, micrometers, veneer presses, bolt clippers, dowel jigs, combination planes, and other less common tools.

The estimated value of individual shop equipment runs all the way from $10 to $3,000. The average investment for machines is $100, for hand tools $90.

Annual Expenditures. The amount spent each year for wood, tools, hardware, paint, metal, and miscellaneous supplies varies from $10 to $2,050 for these shops owners, the average being $128. For wood, from $5 to $500, with an average of $32. For tools, from $5 to $400, the average being $25. For hardware, from $5 to $500, average $15. The estimates for paint vary from $5 to $110, with an average of $12.50.

Projects. Almost every type of project that could be made in a home workshop is listed. Furniture ranks first; models of all types, second.

Reasons for Maintaining a Home Workshop. Thirty-eight reasons are mentioned altogether, but nearly all those replying gave recreation as one of the reasons. Next in order came home repairs, painting furniture, painting home interior, auto repairs, profit, and painting home exterior. To summarize, seventy percent of the shops are maintained for enjoyment, twenty-six percent partly for profit, and four percent mainly for profit.

Distribution of Leisure Time. The average man spends some part of four days each week in his workshop, and the average time is eleven and a half hours a week. The other principal leisure-time activities of the members are, in order of frequency, reading, listening to the radio, auto riding, movies, gardening, fishing, swimming, playing cards, camping, hunting, photography, boating, picnics, lectures, and golf. The fact that reading is the most popular leisure activity is also indicated by the number of magazines read. Every member reads at least one magazine, and some read five or six. POPULAR SCIENCE MONTHLY leads the list by a large margin.

Many interesting points are brought out in Mr. Powell's discussion of the facts revealed by the survey.

"If ranked with any similar group," he writes, "the education of these men would rank equal with or excel the average of the comparative group. Neither previous trade experience nor school work apparently had influenced the owner to set up his shop, but pure interest in the work and want of a leisure activity are responsible for the growth of the home workshop.

"Some of these home workshops have been in existence for a period of thirty to forty years. However, a majority have been in existence only about five years, with a great increase in the past two years.

"In almost every one of the replies received in this study there was an indication for the need of better fellowship. This was evident by the great number of suggestions for displays, competitive projects, local shops for the use of members, shop visiting and exchange of ideas, and meetings occuring at frequent intervals.

"Almost every member seems willing and wants to be able to take a short course in various different kinds of work. This is greatly in evidence among *(Continued on page 104)*

AVERAGE HOME WORKSHOP OWNER NOW REVEALED

(Continued from page 103)

the older members who had no opportunity to take shop courses while in school.

"There seems to be a need for shop classes in school that will start the boy toward the use of a home workshop. He many times is forced to take courses that will be of little value to him in the future, and he has little or no encouragement in the beginning of a hobby."

Mr. Powell also makes a number of recommendations from the educational standpoint and suggests various methods by which the schools can aid the development of the home workshop hobby.

"This study," he adds, "would have been impossible without the assistance of Mr. A. Wakeling, Home Workshop Editor of POPULAR SCIENCE MONTHLY. The writer is indebted to K. F. Perry, Professor of Industrial Arts, Colorado State College of Education, for his help and valuable assistance, and for his part in securing the coöperation of POPULAR SCIENCE MONTHLY and the Colorado State College of Education. The writer also wishes to express his appreciation to the members of the National Homeworkshop Guild who spent their time in filling out the question list."

HOME WORKSHOP CLUBS REPORT ACTIVITIES

Brunswick (Me.) Homeworkshop Club. In order to get the best possible photograph of the club group at a meeting, a prize was offered and all camera enthusiasts belonging to the club were invited to bring their cameras to one of the regular meetings in the Science Building of Bowdoin College. The club provided eight photoflood bulbs to give the necessary illumination. . . . John F. Fraser, of Portland, Me., demonstrated the construction of several types of model airplanes. . . . J. Edward Pomeroy, of Bath High School, talked on blueprint reading.

Bay State Homeworkshop Club, Roxbury, Mass. At the organization meeting of this new club, the following officers were elected: R. H. Fox, president; Constant Albrecht, treasurer; John Pardy, secretary.

Wood-Ridge (N. J.) Homeworkshop Club. A demonstration of building a ship model in a bottle was given at a recent meeting by Charles V. Nielsen, of Hasbrouck Heights, N. J. Mr. Nielsen, who is the leading authority on ship models in bottles, brought a completed clipper-ship model and an empty bottle with him and, after laying putty in the bottle to represent the water, he proceeded to fold up the model, insert it through the mouth of the bottle, and reconstruct it inside by means of long wire tools. He also displayed a number of examples of his work, ranging in size from bottles not more than a half inch in length up to a half-gallon bottle with a completely rigged model of the *Great Republic.* . . . Within two months the club members have witnessed two instructive demonstrations on the use of abrasives.

Capital Homecraft Club, Washington, D. C. E. W. Parks demonstrated the use of an electric router at a recent meeting held in the roomy and well-equipped shop of Frank H. Wildung.

Topeka (Kans.) Homeworkshop Club. The woodworking class meets every two weeks in the shop of William Lewis, who is the instructor. D. E. Elliott is the class secretary, and C. V. Carlson, the class director. The photography class holds it semimonthly sessions at the home of C. J. Boeger, the instructor. R. P. Daniels is the class secretary, and Steve Smith, *(Continued on page 105)*

HOME WORKSHOP CLUBS REPORT ACTIVITIES

(Continued from page 104)

the class director. . . . The Y. M. C. A. has succeeded in providing benches and a tool cabinet for the use of the Junior Homeworkshop Club, and members of the men's club have been asked to supply any tools or accessories they can spare. When completed, the junior workshop will also be available to the Topeka Homeworkshop Club for demonstration purposes.

Mound Builders Homeworkshop Club, Newark, Ohio. Although a relatively small club, the members accomplished the noteworthy feat of making 300 toys for Christmas distribution. These consisted of 100 straddle horses, 100 walking ducks, and 100 doll beds, each complete with mattress, blankets, and a doll. . . . It is expected that the club will shortly reach double the membership it had when organized.

Peekskill (N. Y.) Homeworkshop Club. Thirty-four projects by members of the club were entered in the second annual exhibition and were on public view in a Depew Street store window for a week. Prizes were awarded as follows: furniture class, Vincent Donahue, for a table; model making, Reginald Hart, for a model of the whaling ship *Wanderer;* novelties and toys, Herman MacPeek, for two billiard cues; metal work, Thomas Dore, for an aluminum sugar and cream set; art, Theodore F. Bee, for a pastel of a vase of bittersweet. The judges gave Mr. Donahue the highest percentage and he was accordingly awarded the grand prize. All the prizes were in cash. Special recognition was given to the entries of Bartow B. Seymour, Dr. Willard H. Sweet, Jr., and Peter A. Anderson. . . . Harry L. Towers gave a demonstration on matching veneers at a recent meeting. He showed the various matched grain patterns with the aid of a reflectoscope, which projected an enlarged picture of the actual wood on a screen.

Premier Homeworkshop Club, Chicago, Ill. An exhibition was held at the River Park Field House and various demonstrations given on the use of home workshop machinery. . . . Officers elected for 1936 are Emil Cir, president; W. Anderson, vice president; Henry Wagner, secretary, and E. Brasholz, treasurer.

Lakeside Homeworkshop Club, Muskegan, Mich. At an organization meeting in the manual training room of the Bunker School, the following permanent officers were elected: Frank Pedler, president; Clarence Redman, vice president, and Floyd L. Lewis, secretary-treasurer. Eighteen members were present. The members meet biweekly on Tuesdays in the manual training shop of the Bunker Junior High School, but it is optional to hold the meetings at the homes of members or elsewhere, as desired. Mr. Lewis is the manual training teacher at the Bunker School.

Clarksburg (W. Va.) Homeworkshop Club. The club has adopted the motto, "Every project better than the last." At the end of its first six months, the membership had reached twenty-four. Max M. Rule is the president.

Inland Workshop Club, Spokane, Wash. A dual program of civic work and craft instruction has been adopted, starting with such projects as corner brackets and hanging wall shelves. Each member will make each project on the list in a given length of time and bring the completed item to a meeting, where an instructor will check the workmanship and give advice. The finished articles will then be donated to various children's homes and charitable institutions.

Billings (Mont.) Homeworkshop Club. The club completed another successful program for making toys for crippled and needy children. . . . Regular business meetings are held every two weeks, and on the altenate weeks the members gather at various shops or take trips to industrial plants.

MODERN DESK SET OF SYNTHETIC RESIN

(Continued from page 69)

The upper or pen-holding block should likewise be sanded to a curve. The 1¼-in. face of this block is its bottom and will be attached to the base. The curve, therefore, should be worked back from the 1-in. face along the top of the block until the desired shape has been obtained. After this, two holes should be drilled into the block, each 1¾ in. from the end and each at an angle of 45 deg. to the base of the block. In the set shown, these holes were ⅜ in. in diameter and ¾ in. deep, but the size will vary with the size of the pens you intend to use.

THE two blocks can be attached to each other either by cementing or by means of screws. If screws are used, have them rise upward through the base into the upper part, countersinking the holes so that the screw heads will not protrude. If cement is used, it must be of the special type sold by cast-resin makers. Mix it in the proportions of 6 parts of hydrochloric acid to 100 parts of cement, and prepare no more than will be sufficient for the immediate operation

Apply the cement to both surfaces that are to be joined, lock the pieces in position with two C-clamps, and set aside to dry for twelve hours. It is best to roughen slightly all joining surfaces with sandpaper before cementing. Drying can be hastened by setting the piece in a warm place, but take care that the heat does not exceed 200 deg. F. After the cement is completely dry, the entire piece can be polished as described later on.

Take the remaining half of the full sheet and make a transverse cut to obtain two pieces, each 3 in. wide. Cut one of these into two rectangles, one 4½ in. long, the other 3½ in. long. The smaller of these should be slit on the band saw into two pieces of ½-in. thickness. After being sanded and polished, these should be assembled to form the letter holder of the set. The larger piece is the base, and the two thinner pieces are set upright on this, ¾ in. apart. It will be best to join these pieces by means of screws, set as previously described for the pen-holding block. The screws should be at least 1⅜ in. long.

NEXT, cut from the remaining rectangle of stock a section 4½ in. long and 3 in. wide. Cut from one side of this, a piece ¼ by 1 by 4½ in., and sand it to the shape of the paper knife. The remainder of the block should be cut into two curved sections with a motor- or hand-operated jig saw, each 4½ by 1⅜ by 1 in. These should be cemented side by side to form a 2-in. wide blotter rocker. After the cement is thoroughly dry, the block should be sanded to perfect roundness as illustrated.

From the remaining stock, cut a triangle with 3-in. sides, and resaw this carefully and accurately into four sections, each ¼ in. thick, on a band saw. These will form the corners of the blotter pad and, after being sanded and polished, should be attached to the cardboard base by gluing along the outer edges of the base. This will enable the blotter to be inserted under each corner.

From the remaining scraps cut a section ⅜ by 1 by 1¾ in. and, using a round file, cut three grooves into this to a depth of about ½ in. By slitting this in half and polishing, the two pencil-holding pieces are obtained. These should be cemented to the base itself before the final polishing.

Similarly, a piece ½ by 1 by 1½ in. should be cut from the scraps to form the handle of the blotter rocker. This also should be cemented in place, as shown, before the final polishing. To make the attachment of the blotter to the rocker in the easiest way, cut two small grooves with a hack saw at a slightly downward angle on either side of the rocker just above the end of the curve. These should each be about ⅜ in. deep. Cut the blotter to size and insert the ends in these grooves, using a touch of paste to hold it in place if necessary

When all the pieces are assembled, polishing can be speedily accomplished by following the standard practice outlined in a previous article (P.S.M., Nov. '35, p. 60). The first step is pumice polishing, in which a muslin-disk wheel should be used with a mixture of pumice and water set below the wheel in a pan so that it just touches the bottom of the wheel. A bit of this mixture should be placed periodically on the wheel above the piece being polished. Follow this by waxing, using a special waxing compound (supplied by cast-resin makers) or carnauba wax or a clear, powdered floor wax. Follow this with a dry buffing on a clean wheel. In all cases, the higher the speed of the wheel, the higher the polish. A speed of 2,500 r.p.m. on a 6-in. muslin disk wheel is ideal.

To prevent scratching the desk or table, paste felt strips on the bottoms of the pen-holding block and the letter holder, and, if desired, on the bottom of the entire blotter pad.

HOW TO GET DIMENSIONS OF MACHINE PARTS

USUALLY when making sketches from assembled machines, it is quite a problem to get the necessary dimensions because of the inaccessibility of the parts or their irregular shape. Many of the measurements, however, may be obtained by means of paper rubbings. The contour of a cam, the center distances and layout of a group of boltheads, the size and shape of gear teeth and other parts can be accurately measured and recorded by placing a sheet of paper on the more or less oily part and rubbing the opposite side with the fingers.

Diameters of round parts not otherwise measurable can be found by wrapping a narrow strip of paper around them, marking the lap, and afterward dividing the length by 3.1416. The same may be done with gears, when not in mesh, and the paper will record both the diameter and the number of teeth. Although strips of paper cannot be wrapped around gears that are in mesh, a rubbing of any large fraction of the surface at the sides will furnish a record from which, by means of dividers, the diameter and the number of teeth can be determined.

In the case of cylindrical parts having details such as holes, slots, or cam grooves on the surface, paper rubbings will give a complete and fairly accurate record from which the diameter and the location of all surface details may be obtained.—HARRY KAUFMAN.

PAPER FOR MODEL WORK

WHEN ordinary white paper is to be used in building parts of models, it can be made five or six times stronger by soaking it in strong nitric acid. This should be done in a china dish or enamel tray. After soaking the paper for five minutes, rinse it thoroughly for half an hour in running water, then dry. Be careful that the acid does not come into contact with the hands or clothing.—A.Y.

• • •

DENTS and cuts in britannia metal, of which prize cups are made, can be filled with an amalgam of pure tin and mercury. After the amalgam has set, polish it down evenly. This takes the place of soldering, which is always risky with soft metal alloys.—E. B

THE WORLD IS MOVING

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- **BOOM**---another fallacy passes.

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And this applies to you—and your job!

What are you doing about it . . . just standing still?

Wake up, get in action! Equip yourself today . . . in spare time . . . for the sprint that leads to success . . . to security . . . to a better job . . . to more money!

The race is on. **Many of your competitors (they may be close friends, too, but they're earnest competitors, don't forget) are in serious *training* . . . they're devoting every possible moment to the mastery of International Correspondence Schools Courses. This is real *training* . . . it's not for slow-pokes and quitters! Only men who mean business in a fast-moving world need apply. The card is *your* application blank.**

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___Concrete Construction	___Bridge Engineer
___Contractor and Builder	___Gas Engine Operating
___Structural Draftsman	___Automobile Work
___Structural Engineer	___Fruit Growing
___Structural Steel Worker	___Poultry Farming
___Electrical Engineer	___Mathematics ___Radio
___Electric Wiring	___Business Management
___Electric Lighting	___Office Management
___Electric and Gas Welding	___Industrial Management
___Telegraph Engineer	___Traffic Management
___Telephone Work	___R. R. Section Foreman
___Mechanical Engineer	___R. R. Bridge & Building Foreman
___Mechanical Draftsman	___R. R. Signalman
___Machine Shop Practice	___Accountancy
___Reading Shop Blueprints	___Cost Accounting
___Toolmaker ___Boilermaker	___Certified Public Accountant
___Heat Treatment of Metals	___Bookkeeping ___English
___Inventing and Patenting	___Private Secretary
___Civil Engineer	___Spanish ___French
___Aviation Engines	___Salesmanship
___Diesel Engines	___Service Station Salesmanship
___Plumber and Steam Fitter	___Advertising
___Plumbing Inspector	___Business Correspondence
___Heating and Ventilation	___Show-Card Lettering
___Air-Conditioning	___Sign Lettering
___Sheet Metal Worker	___Stenography and Typing
___Steam Engineer	___Civil Service
___Steam-Electric Engineer	___Railway Mail Clerk
___Marine Engineer	___Mail Carrier
___Refrigeration	___Grade School Subjects
___Highway Engineer	___High School Subjects
___Petroleum Refining Plant	___First Year College
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___Structural Draftsman	___Automobile Work
___Structural Engineer	___Fruit Growing
___Structural Steel Worker	___Poultry Farming
___Electrical Engineer	___Mathematics ___Radio
___Electric Wiring	___Business Management
___Electric Lighting	___Office Management
___Electric and Gas Welding	___Industrial Management
___Telegraph Engineer	___Traffic Management
___Telephone Work	___R. R. Section Foreman
___Mechanical Engineer	___R. R. Bridge & Building Foreman
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___Air-Conditioning	___Sign Lettering
___Sheet Metal Worker	___Stenography and Typing
___Steam Engineer	___Civil Service
___Steam-Electric Engineer	___Railway Mail Clerk
___Marine Engineer	___Mail Carrier
___Refrigeration	___Grade School Subjects
___Highway Engineer	___High School Subjects
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One year from today will you still be putting off your start toward success . . . thrilled with ambition one moment and then cold the next . . . delaying, waiting, fiddling away the precious hours that will never come again?

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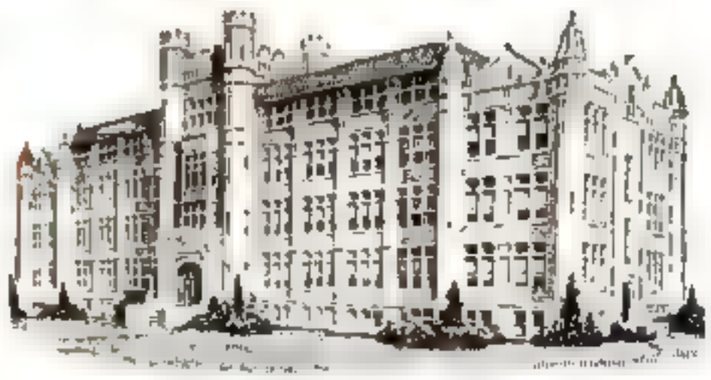

FIRST STUDENT ENROLLED OCTOBER 16, 1891

TOTAL ENROLMENTS

December 31, 1891	115
December 31, 1895	10,105
December 31, 1900	251,310
December 31, 1920	2,271,193
December 31, 1935	4,119,000

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HOW TO MAKE LIFELIKE MARIONETTE BODIES

(Continued from page 65)

the wooden parts firmly in the vise while working on them. You will accomplish more in a shorter time and with less exertion than if you try to hold the parts.

Shoulders. Whittle this piece from a block as wide as the shoulders and as thick as the body through the chest. It should extend slightly below the armpits. Slope the shoulders and cut quite a hollow for the neck, leaving it high in the back but sloping well down on the chest (Fig. 2). In the middle toward the back, drill hole through which the wire may be drawn. Leave a loop at the top to which the head is attached. Bend the ends of the wire back and tack firmly (Fig. 3). Length of neck should accord with character of figure.

Hip Piece. Whittle according to your sketch as to depth and width (Fig. 4). Use muslin or the ribbed top of a stocking to join chest and hip pieces, tacking it as necessary (Fig. 5). It is sometimes advisable to weight the hip piece as in Fig. 6. A puppet so weighted will sit better.

Legs. Cut ¾-in. dowel to length and whittle roughly to shape, tapering toward ankle. Choose from Fig. 7 the hinge you prefer to use. All hinges need a tape strip in back. The thigh is formed from a short piece of dowel around which is tacked a piece of muslin about 1 in. wide and 3 in. deep. The end of the muslin is tacked to underside of hip piece (Fig. 8).

The feet may be modeled on the leg with paper pulp as in Fig. 9 or whittled from wood like Fig. 10. If modeled, it is necessary to cut thin wooden soles and nail them to the lower leg dowels. When dry, boots or shoes may be simulated by pasting on paper, cloth, or leather, or by painting. Feet of wood are excellent, especially if hardwood is used, as it weights the parts. Be sure to get them large enough. The drawings show different ways of joining them to the legs. An ankle joint is not always necessary (see *A*, Fig. 7). Women's figures rarely need them; and if long skirts are worn, even leg strings are omitted.

Arms. Only the forearm need be stiff. The upper arm is a hollow tube of muslin, slightly stuffed (Fig. 11). Hands modeled of paper pulp are satisfactory. If the character is to wield a tool or weapon of any kind, a hole is left through which handle can be thrust (Fig. 12). Hands should be expressive in shape as well as in action. A hand can do marvelous things when controlled by a clever manipulator. It can show shaky old age, nervous excitement, calm repose, strength or weakness. It can fence, spar, draw a sword, swing a hammer on an anvil. A rhythmic song sung at the same time helps the action.

Hands may also be shaped in fine wire as in Fig. 13 and wrapped with adhesive tape, muslin, or crêpe paper, later being painted and shellacked. A piece of ⅜-in. tape about 4 ft. long may be used to wrap each hand, fingers, and arm, leaving a loop of wire exposed at the elbow for connection. Instead of tape, hands may be wrapped with narrow strips of flesh-colored crêpe paper. Wind tightly and use paste whenever necessary (Fig. 14). Sew the forearm and hand to the upper arm, and tack this part to the shoulder. Finger tips should reach halfway between hips and knees.

Costumes. It is great fun looking up native costumes for your marionette actors. Make clothing of soft materials; thick or stiff fabrics hamper the puppet's work. Keep the clothing loose so that the puppet moves easily. Use gay colors where possible and characteristic caps and headdresses. *(Continued on page 110)*

HOW TO MAKE LIFELIKE MARIONETTE BODIES

(Continued from page 109)

Controllers. Experienced operators now often simplify them, preferring two sticks 9 in. long made of ½-in. dowels. To one is attached, by means of grooves or notches sawed near each end and in the middle, the two head strings and the string to center back. To the second stick the leg strings are tied near the ends, and 1½ in. farther in, are tied the hand strings.

If a T-shaped controller is preferred, cut ¼-in. wide strips from cigar-box wood, the main piece being the length of the operator's hand and the crosspiece equal to the span of the hand—approximately 7 by 9 in. An extra piece 8 in. long is needed for the leg strings. It requires a small hole in the center to slip over a wire nail or peg on the main piece. Cut a ¼-in. wide strip from an old inner tube, and draw it through holes drilled in the crosspiece to form a loop for supporting the puppet. This leaves the operator's fingers free for manipulation. When not in use, the puppet is hung by this loop.

Stringing a Marionette. This is done after the puppet is dressed. When stringing, hang the puppet about 50 in. from the floor. The string is run taut to every place but the back and legs, which should be a bit slack so that the control may be slipped over a brad without disturbing the feet when they are to remain motionless or when the puppet is seated. Use heavy black linen thread or any strong waxed thread.

There are five screw eyes to be put on the body before the puppet is dressed, and two on the head, as follows: Two for the shoulder strings; one on the back, just above or just below the waist; one on each leg just above the knee joint; and one back of each ear. The screw eyes for the head are usually just above the ears, but they must be placed so that the greater weight of the head is in front. When the shoulder strings are pulled, the head then bends forward instead of back. For a pompous strutting character, place the screw eyes forward; for old age or a hunchback, set them far back. Between these two extremes is the normal place.

The strings are sewn through the clothes, never fastened directly to them. The hand strings are fastened between thumb and first finger.

The length of the strings depends on the height of the puppeteers' bridge above the puppet stage. About 50 in. is an average length from the control stick to the feet of the puppet. First suspend the controller at the exact height from the floor that the combined height of the marionette and the strings is to be. To find this distance, measure the puppeteer from waist to feet, and to that length add the elevation of the bridge from the stage floor, if it is raised.

Cut a piece of thread 3 in. longer than double the distance from the controller to the marionette's shoulder, as the marionette is held upright with its feet on the floor. Tie one end securely to the marionette's left shoulder and the other to the right shoulder. Cut the thread in half and attach these ends to their places on the controller. The marionette is now supported upright. Tie a thread to the screw eye in its head near the left ear; measure double the distance from this point to the controller, with the head erect; allow 3 in. extra and cut the thread. Tie the other end to the right ear loop, cut the thread in half, and fasten the ends to the controller.

The head is now supported. Be careful that the weight of the body hangs from the shoulder strings; if these are slack, the head strings are supporting the whole marionette and head movements will be stiff or impossible.

Next, tie a string *(Continued on page 111)*

HOW TO MAKE LIFELIKE MARIONETTE BODIES

(Continued from page 110)

to the left hand, measure up to the controller and back, and allow 3 in. extra, cut, pass the free end of the string through the proper controller hole, and tie to the right hand. This string or thread is continuous. Arms are raised by placing a finger under the string and lifting it. A ring may be slipped over the string at this point so that it may be lifted more conveniently.

Tie a thread to the back screw eye, using a needle to draw it through the clothing if necessary. Draw this thread up to the hole in the back of the main control bar; cut and tie securely. By lifting this string, which is slack, the puppet can be made to bow.

In the same manner, secure the strings to the knee screw eyes, and tie them to the extra crosspiece of the controller. Legs and arms should hang limp when not in use. To make the puppet walk, tip the leg rod of the control up and down.

The marionette is now strung and ready to manipulate. For strings to work tricks or to control extra movements, extra holes may be drilled in the controller where required

It is best to keep puppets hanging up. Never lay a puppet down without first winding the strings around the control to prevent tangling.

Manipulation. Hold the controller in the left hand by the stock, close to the crosspiece, if it is T-shaped. Tip and tilt the control, and also pull the shoulder strings with the first finger. In other words, learn to do all you can with the left hand before using the right hand at all. The right hand is used for the leg control (or walking stick) and for the hand strings. Manipulate all strings close to the controller; never reach down under. The puppet who is supposed to be speaking should be in movement while doing so; the others must be still.

Puppets are limited in action. If they are overtaxed, they soon become ridiculous. There are certain things they do well, flying, for instance. They grieve and die with heartrending realism. Their head and arms make the most expressive movements. They should all kneel and sit well.

Avoid long speeches; they are rarely successful. Fairy tales, no matter how worn out the plot may be, take on new life when acted by puppets. Better have but few characters in the play, as only two or three can be well managed on the stage at one time.

Due to the difficulty of restringing, it is necessary to make two puppets alike if it happens that the costume must be changed.

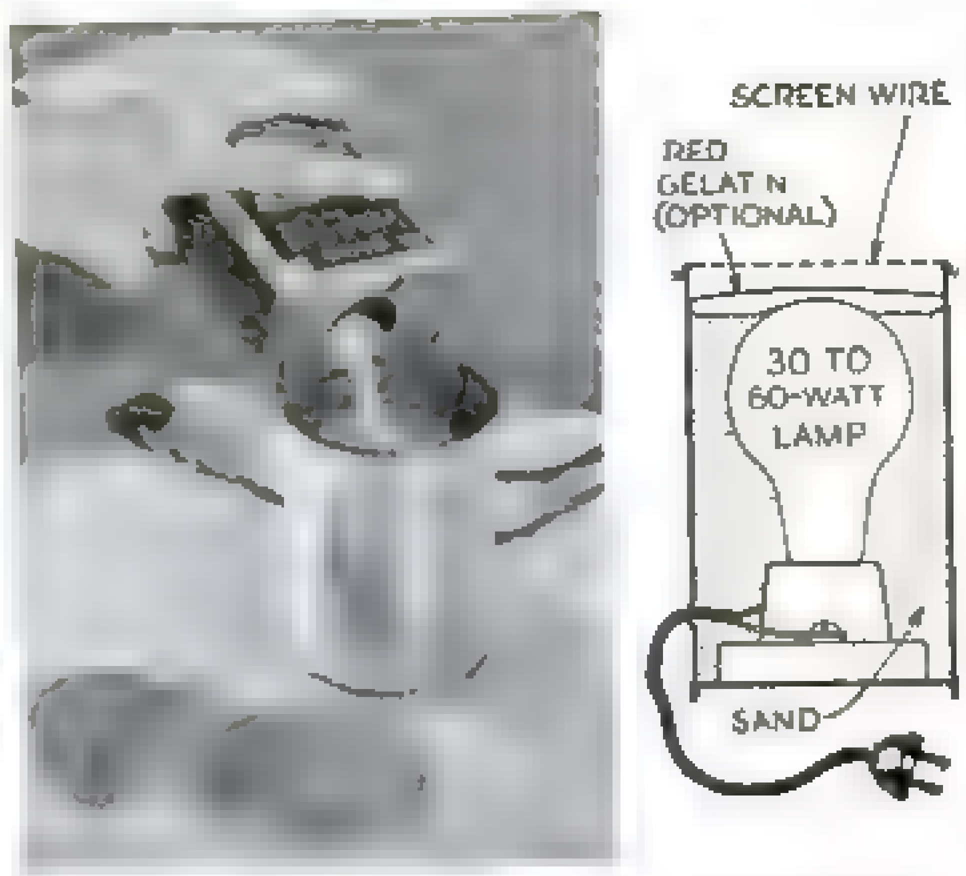
Try to have nothing on the stage in which the strings will become entangled, and don't forget to keep everything as simple as possible. Strings that get tangled, stage properties that fall or move about, back drops too detailed in treatment, all these distract attention from the characters.

The curtain should rise and fall many times. Have puppets enter and leave often. A puppet can leap twice his height in the air when surprised. Let another go out dancing a hornpipe. In a two-man show, an animal, creeping up behind another figure, is always pleasing (see P.S.M., Dec. '35, p. 67).

An article on marionette stages by Mrs. Drake is scheduled for early publication.

FLAGPOLE ORNAMENTS

IT IS often difficult to obtain a ball or spread-eagle flagpole ornament of the required size and at a reasonable price. This happened in my own case, but after some searching I happened upon a stock of radiator-cap ornaments. These are made in great variety and are easily fastened to either the pipe cap of a metal pole or to a wooden pole.—J. KRAUS.



An electric lamp mounted in a tin can and surrounded by sand makes a handy heater

YOUR MICROSCOPE SHOWS BEAUTIES OF CRYSTALS

(Continued from page 45)

entire area of the drop. If you remove the source of heat as soon as the edge deposit appears, crystallization will proceed at a slower rate. Under the microscope, you will see that the edges of the area of solid material, formed while the slide was being heated, have a structure that differs from that of the central portion. Yet all the solidified material has crystallized according to an unvarying plan provided, of course, there is but one crystalline substance present.

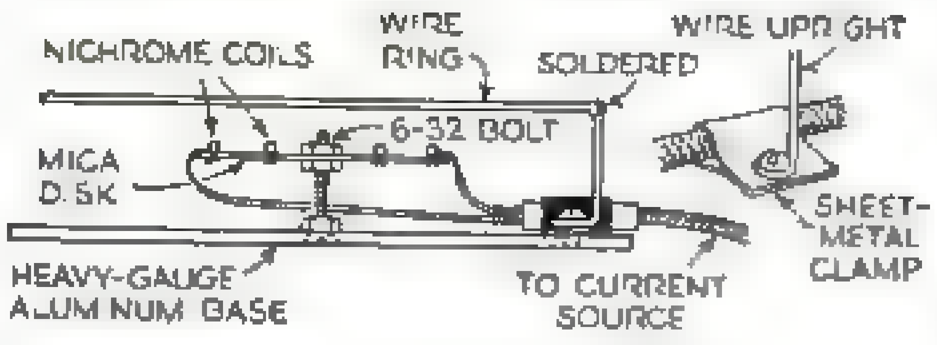
Crystals exist abundantly in nature. Perhaps no more beautiful forms are to be found than the masses of crystals that fall to the earth as snowflakes. Snow crystals belong to the hexagonal or six-sided system. Perfect snowflakes always have six sides or rays or points. So endless are the possible ways in which the crystalline form can be varied, that no one ever has found two identical snowflakes. Some flakes consist entirely of thin plates, others of heaped-up prisms, and still others of combinations of these forms. The angles bounding these snowflake figures are always sixty or 120 degrees.

THE microscopic study of snowflakes requires certain conditions. The temperature must be low, from twenty-five degrees to zero F. being favorable. The microscope and all equipment must be at the same temperature. Generally, it is possible to work in a garage or on a sheltered porch, where temperature conditions are right. You can collect the flakes on a piece of black hard rubber, a painted board, or a piece of black cloth that has been outdoors long enough to acquire the temperature of the surrounding air.

Hold the collecting board where the flakes will fall on it. You can select the most promising flakes and transfer them to cold glass slides with the aid of feathers; or you can collect them on the slides in the first place, by laying clean slides on the board. Instead of standard slides, you could use thin one- by three-inch pieces of hard rubber or wood painted black. Most of your observing will be by reflected light, so that you do not really need a transparent support.

A snowflake will not last very long because, even at a low temperature, the ice crystals evaporate. The only way to preserve the beauty of its form is to make a photomicrograph of it. In doing this, you cannot use artificial light sources because they produce too much heat. Try making pictures both by transmitted and by reflected daylight.

It is not a difficult matter to preserve indefinitely many of the crystalline wonders you create by evaporating solutions. Some materials, such as rhombic sulphur, will exist indefinitely in air, so that they can be mounted on a glass slide without an embedding medium. A convenient *(Continued on page 113)*



Details of construction of electric resistance heater easily wound from nichrome wire

YOUR MICROSCOPE SHOWS BEAUTIES OF CRYSTALS

(Continued from page 112)

way of doing this is to cut a ring, from cardboard or other material, whose outside diameter is slightly greater than that of the cover glass you are going to use, and whose inside diameter is somewhat less. Soak this ring, if it is not of moisture-proof material, in thin shellac and let it dry. Cement it in the center of a clean one- by three-inch glass slide, with Canada balsam.

Over the bottom of the cell thus formed, spread a very thin layer of balsam and let the solvent evaporate. When the balsam film has hardened, arrange the crystals over it. Then gently warm the slide until the balsam becomes sticky enough to cause the crystals to adhere. If you cannot do this without damaging the specimens, put the crystals in place before the balsam has dried completely, or flow a little xylol over the hardened film. Finally, cement a clean cover glass over the cell, using balsam around its edges.

Many crystals, such as those of the double sulphate of copper and magnesium, must be preserved so that no water can get to them. When the crystallization has progressed as far as you want it to go, heat the slide gently to stop further crystal formation. Then apply a little pure balsam, and drop the cover glass into place. It is important that all of the crystalline area be covered with the balsam, so that no moisture can creep in.

Crystals can be mounted in castor oil. It is better to use the refined variety to avoid an odor, which is unpleasant to some people. Place a drop of oil over the crystals, then a cover glass, and your specimen will keep indefinitely, provided the oil or cover glass is not removed. Permanent slides, which will last for years with reasonable care, can be made by removing all excess oil with a piece of filter paper moistened with xylol, and ringing the cover glass with gold size. Place the slide in a horizontal position until the gold size hardens. Give it another application if necessary, and finish by ringing with asphalt varnish.

IN PREPARING specimens of crystals, and in doing a great many other things in microscopy, a source of heat is desirable. While the Bunsen burner and alcohol lamp have become standard pieces of equipment in laboratories the world over, there are times when a source of heat not involving a flame is desirable. A small electric heater fills the bill nicely.

One form of heater can be improvised from an empty tomato can, a lamp socket, asbestos-covered wire of the kind used for electric irons and toasters, connection plug, incandescent lamp, and some clean silica sand or "bird gravel." Mount the socket inside the can, on the bottom. Connect the wires to the terminals, and lead them out through a hole punched in the side of the can. Seal the wires in this hole by forcing about them some shredded asbestos or other material that will resist heat.

Screw the lamp into the socket, and pour sand around it until only the top is visible. The sand is to prevent heat from escaping in appreciable quantities except at the top. Cover the top of the can with a piece of copper screen wire, to act as a support for slides or containers. If *(Continued on page 117)*

Secrets of Success

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Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 500 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

THIS COURSE LED TO AUTHORSHIP

It probably would not be fair to say that the course I took in the ——— Correspondence School taught me how to write. I had high school, college and theological seminary back of me. And I had already done a great deal of writing. My difficulty was not in writing but in finding some market for the things I wrote. That is just where the correspondence school came in.

I was a minister, pastor of a village church, with time on my hands for literary work. Not securing a sufficient number of sales of my articles, I enrolled in the school and when the course in magazine writing was completed, I took a second, this time in short story writing. Some of the things I learned were studying the market, writing for the market and writing in a style which the market demanded.

I found that most editors desired information rather than finesse of style and that the average grammarian is stupid—in style—when it comes to competition with present day newspaper and magazine writers. I found also that there is little market for philosophic generalizations but a very wide market for specific informative material.

Secrets of Success

Since then I have had articles in dozens of periodicals, ranging from Sunday School publications to nationally known magazines. At present I am editor of *Church Management*.

Would-be writers, more than anything else, should know that it is not sufficient to write. The technique of expression is but one thing. One must write from knowledge and experience. The thing about which you write must be interesting. Many who will not have an opportunity for a full time job as a writer will find training helpful for part time activity.—*W.H.L., Ohio.*

"WONDERFUL AID" IF YOU WANT TO LEARN

For the past twelve and a half years I have been connected with the Overhead Line Department of the ——— Street Railway and while I have not arrived at the top which I hope to reach some day, I feel that I have benefited from a correspondence school course and that it is certainly responsible—in part, at least—for what I have accomplished so far.

From my earliest recollection electricity and mechanics had always fascinated me and as I grew up I intended to study them. But unfortunately when I finished high school in 1922 I was unable to go on through college because of financial reasons. Instead, I went to work as a clerk in a grocery store.

My first week's salary, however, went for a down payment on a correspondence course and I was enrolled with the ——— School as a student in electrical engineering. During the next eleven months I worked as a clerk in several stores and studied at night, all the time trying to get a job in the electrical line.

Thanks to the efforts of a representative of the correspondence school, I finally obtained a job with the street railway as a laborer on a pole setting crew. After a few months I was put on the electric welding crew, or bonding crew as they were called. This crew tested and repaired all electrical connections to the track as well as miscellaneous jobs for the Overhead Line Department.

In January 1925 plans had been made to reconstruct the feeder system from a central station supply to supply from four sub-stations with accompanying changes in feeder and transmission lines. Some one was needed in the office of the Overhead Line Department to assist with estimates, blue prints, and construction records.

My employer, himself a student of the same correspondence school, had taken an interest in me and offered me a chance at this job and with it went a substantial increase in salary.

A few months later the local public utility company started a program of expansion extending its services to several small towns within the radius of twenty to fifty miles. My boss was put in charge of part of this work and I was able to secure a part time position assisting in laying out pole routes, estimating the size and location of transformers, and locating

Secrets of Success

the wires in these villages, still retaining my connection with the railway company.

During the real estate boom in Florida, I helped lay out plans for the electrical system of a proposed new town down there. I worked on these plans at night and during my spare time, and had accepted a job to install this system and operate it when the bubble burst. Happily I had not yet resigned from the railway company.

Since that time I have assisted in the installation of the overhead construction of the first trackless trolley coaches operated in this city, and in the maintenance and operation of the overhead wires of the street railway system. I am now rated as an assistant engineer in the overhead line department.

If you can attend college . . . fine! Go and study hard. But if finances prevent a college education, a home study course is a wonderful aid if one has the determination to learn. Thanks to my training, I have been able to provide a comfortable living for my wife (whom I married in 1926) and two children all through the depression.—*C.F.C., Tennessee.*

LIKES TO WORK SOME THINGS OUT ALONE

Home study courses are a hobby with me. They have enabled me to take up subjects not included in my college curriculum—at least not coming under the head of those required for my particular degree—when I could not afford to enroll for additional work away from home.

I have found it very convenient to delve into lessons at odd moments which might otherwise have been wasted. Contact with instructors, even though only on paper, was pleasant as well as profitable. I could easily increase my knowledge and keep on with my regular job.

Although there are undeniable advantages in class room recitations, I find it a comfort to work some things out alone. My mental processes may be peculiar, but when my brain "locks" on any question, the presence of other people is a hindrance, especially if those others get the idea quickly and clearly, and I am "sunk." With a properly written book before me, I can almost invariably work it out until it sinks in and I *know* what I am doing.

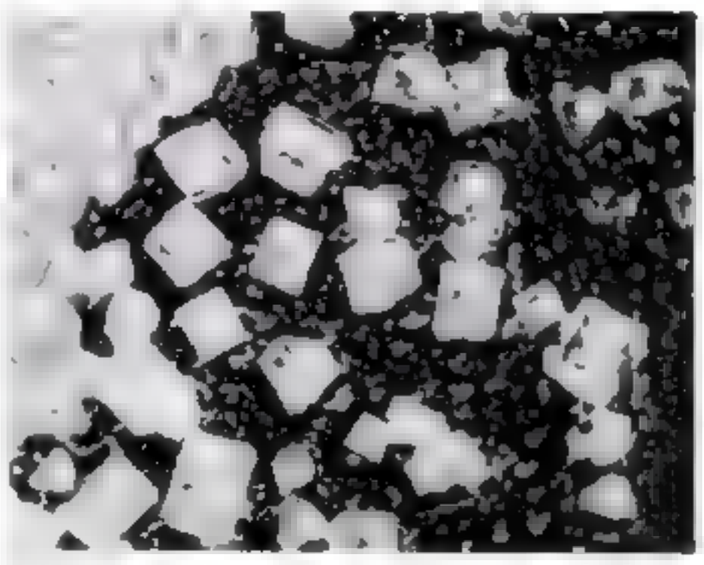
Then, too, I find relaxation in studying some favorite subject. I have taken advertising, short story writing and magazine journalism—oh yes, and one course in efficiency—and enjoyed every one. I may take some more when I am sufficiently inspired and have the time and money. Believe me, I'm for 'em!—*P.H., Nebraska.*

YOUR MICROSCOPE SHOWS BEAUTIES OF CRYSTALS

(Continued from page 113)

you want to subdue the light from the lamp, add a disk of red, fireproof transparent material of the type used over show-window lamps, spotlights, and the like. An added refinement is a covering of asbestos around the outside of the can, to act as an insulating layer when the heater is operated for considerable periods.

In using this heater, be careful not to run it so long at one time that the lamp will be damaged. A lamp of the old carbon type, which gives more heat than light, can be used. Some of the special therapeutic or electric-heater lamps can be employed. Special lamps made for use inside ovens ought to prove satisfactory, if the imprisoned heat seems to damage ordinary lamps. When ordinary



This fantastic wonderland is composed of potassium bromide crystals, magnified 300 times

inside-frosted bulbs are used, thirty-, forty-, or sixty-watt sizes are about right, depending on the intensity of heat that is best suited for the work being carried on.

If you have a transformer for operating a 108-watt microscope lamp, or a toy transformer of sufficient capacity (such as the 150-watt size), you can wind a resistance unit from nichrome resistance wire, experimenting to find the proper length. The wire can be wound in a pancake spiral or zigzagged like the letter M, and mounted on an insulating, heat-proof support such as a piece of asbestos, slate, or mica. A mica disk taken from a burned-out fuse plug is excellent. Use fairly fine resistance wire, something like No. 28. A foot or so ought to be about the right length, for operation on four to six volts; but the best length can be found by test. Make a springlike coil by winding the wire around a darning needle, and then fasten the coil to the support. One way of doing this is to punch or drill holes in the support at intervals along the coil, bend short lengths of the resistance wire into the shape of a hairpin, and use these as staples to pass through the holes of the mounting support.

MOUNT the heater unit on an upright brass bolt passing through the center of a rectangular piece of sheet aluminum or other metal big enough to form a rigid base. The coil should be about one half inch above the plate. Bend a piece of stiff brass wire into a ring, with one end projecting to form a leg, and mount it as shown in the illustration to make a support for the specimen slide which is to be heated.

Connect the ends of the resistance wire to insulated wires running to the transformer secondary, and your heater is complete. You will find that a little heater of this type is surprisingly efficient, and one of the handiest pieces of equipment you can add to your microscope laboratory. Because of the low voltage used, there is no danger of shock; and it is safer to use, from a fire-hazard standpoint, than the conventional heater which employs an open flame.

MERCY FLYERS BRING RESCUE FROM THE SKY

(Continued from page 21)

persons dead in the ruins and 7,000 injured lying in the streets. With radio towers wrecked, submarine cables snapped, all bridges leading into the city washed away, and the harbor bottled up by a sunken dredge, the victims were cut off from the world. Only by the sky road could assistance reach the stricken city.

Radio men at the Pan American air-line field rigged up a short-wave set and flashed an SOS. By the following morning, great birds of wood and metal, birds of mercy, were heading for Santo Domingo City with doctors, serums, medical supplies. Within a few days, 37,800 pounds of medical supplies alone—typhoid serums, tetanus serums, gauze, bandages, morphine tablets, ether, hypodermic needles—reached the city by plane and averted thousands of additional deaths.

LATER, the same year, swollen rivers in Alabama, Georgia, Mississippi, and Florida flooded more than a million acres and endangered the lives of 76,000 persons. Army planes from Maxwell Field, near Montgomery, Ala., made 296 flights, an average of almost fifty a day, while the flood was at its height. In addition, Navy airmen flew 15,000 miles in six days. Together, they saved thousands of lives by dropping food and supplies and by reporting the location of refugees.

During one of these flights, Lieut. W. H. Higgins and Corporal Woodward had a narrow squeak in a big observation plane loaded with supplies. They were clipping the tree tops, not far from Andalusia, Ala., when the excitement began. But, let the pilot tell the story.

"We had just sighted several marooned people. Suddenly, the motor started to vibrate violently. The power dwindled to almost nothing. My first inclination was to jump, but, knowing we were too low, I made for the open water of the Conecuh River.

"We hit at sixty miles an hour. The plane whipped over on its back, throwing Corporal Woodward clear of the ship. I was trapped in the cockpit with my parachute. I didn't know I could work so fast but somehow I got my safety belt unclasped and my parachute floated me to the top. Corporal Woodward had floated to a log jammed against some pine trees. I joined him and we ripped the pads from our parachutes to use as floats.

"The current carried him into midstream and he soon outdistanced me. I swam and floated for half a mile until I saw an old house sticking half out of the water. A window to the attic was open. Inside were some clothes and quilts hanging on a peg. I was shivering, and changed into the dry clothes. Then, men in a boat came along and we went on down the river where we found Corporal Woodward in the top of a pine tree."

THE adventure ended in a laughable anticlimax. For Corporal Woodward had found a skunk in possession of the tree top and the evidences of the skunk's reception were carried on the breeze for half a mile around.

It was during this flood that an outboard motor was dropped from the sky for the first time to aid in rescue work. Attached to a parachute, it was carried aloft packed in hay, wrapped in canvas, and dangling from the bomb rack of an Army plane. Above a levee at Brewton, Ala., the pilot swooped down, released the motor, and saw it drift to a landing in shallow water near the waiting flood victims. Attached to a skiff, it speeded up the work of taking people from partly submerged trees and houses.

Most articles dropped from aloft are packed in hay or excel- *(Continued on page 119)*

MERCY FLYERS BRING RESCUE FROM THE SKY

(Continued from page 118)

sior. Experience has taught a number of things about the right way to safeguard supplies delivered by plane. For instance, sacks of coffee, beans, and flour are always packed only half full. Full sacks, no matter how carefully they are packed, burst on striking the ground. Canned goods usually come down a single can to a package, wrapped with rounded corners so it will roll like a ball.

So expert are some disaster pilots at dropping these "peace bombs" that they can place them directly on levees or high spots ninety-nine times out of a hundred. In several cases, they have planted the needed food on roof tops sticking up out of the water where flood victims were waiting for rescue boats to take them off.

A YEAR or so ago, a brash young baseball player was among the refugees marooned on the top of a knoll. When a relief plane circled low and gave four blasts of its motor, the other flood victims scattered to the edges of the open space, but he set himself to catch a fly. Down came a can of tomatoes padded with excelsior and wrapped in burlap. It landed right in his hands and the next thing he knew he was flattened out on the ground, being helped up by his friends. Although supplies are dropped when the plane is as near the ground as possible, they land with considerable force.

Consequently, large objects are always attached to parachutes. In a number of instances, five-gallon milk cans, protected by padded canvas covers, have floated down from bombing planes with food and drink for hurricane, flood, or earthquake sufferers.

In 1932, the strange "moonlight hurricane," which devastated parts of Southern Texas, gave relief planes another chance to demonstrate their ability.

After ripping across Cuba, the whirlwind crossed the Gulf of Mexico and struck Texas along a 200-mile front, extending from above Corpus Christi to Brownsville. At Corpus Christi, an immense steam whistle blew a shrill blast at ten-second intervals to warn of the approaching hurricane. With streets deserted, houses boarded up, and citizens huddled in stormproof structures, the community waited for the storm to strike.

Suddenly, the rain ceased, the black clouds parted, and brilliant moonlight illuminated the drenched streets, the whipping trees, and the crashing breakers. Then, as suddenly, the clouds rushed together again and the hurricane struck in a screeching, 100-mile-an-hour wall of air. It wrecked houses, sent automobiles rolling over and over like tumble-weeds, snapped wires, tore out bridges, and left twenty-two dead and 1,500 injured behind.

AT THE first word of such disasters, the flying Minute Men of the Red Cross go into action with their radio and planes. In addition they carry directing officials, shuttling back and forth across the map as the work shifts from one battle front to another.

Even when large-scale calamities are not present, they often guide their ships through the sky on errands of mercy. Not long ago, for example, one pilot raced three fourths of the way across the United States with a special kind of serum to save a woman's life. And, frequently, when persons are stricken at lonely outposts, they receive aid or are transported to hospitals by plane.

According to officials of the American Red Cross, an average of eighty-two disasters a year claim the attention of that organization. In caring for the needs of sufferers, increasing reliance is being placed on daring airmen, the disaster pilots who ride the skyways to aid in rescue and relief.

GUS TELLS HOW TO SPOT IGNITION TROUBLE

(Continued from page 56)

cam stayed on the job. That's how it happened."

While Gus was saying this, he had fished a feeler gauge out of his pocket and reset the gap at its proper opening.

Backett grunted. "And how was I supposed to figure out a tricky thing like that?"

"Well," Gus smiled, "if you hadn't been so sure it was in the plugs, you'd at least have spotted the loose timer contact. Start her now, and see if that wasn't it."

The motor hummed smoothly on all cylinders, and Backett grinned. He looked at his watch. "Too late now to get over to Parksburg in time to catch the man I wanted to see. Have one, Gus," he said as he pulled two cigars out of his pocket. "I feel cheap about dragging you all the way out here. Put it on the bill, of course. If you're not in too much of a hurry, I wish you'd spend a few minutes explaining how to avoid getting off on the wrong foot in locating ignition troubles."

"It's mostly a matter of keeping your mind open as well as your eyes," Gus began, after the cigars were going well.

"REMEMBER, first, that there's hardly any trouble that can happen to a car that can't be due to several different causes, just like there are a lot of things that can give you a stomach ache or a pain in the back. Take this matter of engine missing. It can be due to bum plugs or loose timer contacts as you've seen, but it also might be caused by dirty, worn, or pitted timer contacts, burned-away distributor points, a cracked distributor head, a loose timer wiring connection, leaky high-tension wiring, or a partial breakdown in the coil or condenser.

"Then," Gus went on, "there's a string of carburetor troubles that'll make a motor miss—"

"Hold on!" Backett laughed. "Just stick to the troubles that are in the ignition system. If you can tell me how to sort them out, that'll be about all I can soak up at one time."

"All right," Gus agreed. "The first thing to do when a motor starts missing is to listen closely to see whether it's a regular miss that may be in one cylinder, or whether it seems irregular and not in any one cylinder. If the missing goes away for a while and then starts again, that's important, because it tells you that the trouble isn't a complete breakdown, and is quite likely to be a loose connection.

"If the miss is always in one cylinder, then you can forget about all the troubles that would cause random missing, such as a loose connection in the wiring, or coil or condenser failure. That narrows the list of possibilities to a shorted plug, a bad wire leading to it, or a crack in the distributor near the point that feeds current to that particular plug, and, of course, the particular form of timer trouble you just had—which is the rarest of all."

"I CAN get that fixed better in my mind if I can see what you're talking about," Backett interrupted, as he lifted the hood again. "That means," he went on, as Gus looked over his shoulder, "that if I found with the aid of a screw driver that there was no spark at this particular plug, I'd change to a spare, and if that didn't do any good, then I'd examine this wire leading to it, first making the test you did."

"And the only places you'd have to examine would be where it touches metal, because it couldn't leak anywhere else," Gus added.

"That's so," Backett agreed. "Then I'd look over the distributor head to see if I could find a crack in it, and, if I didn't, I'd look into the timer for a loose fixed contact."

"That's it, ex- *(Continued on page 121)*

GUS TELLS HOW TO SPOT IGNITION TROUBLE

(Continued from page 120)

actly," Gus approved. "Line up your possibilities and go through them one by one.

"You can follow the same idea if the miss seems to be in first one cylinder and then another. Start with the timer contacts first, because they're the most probable cause of missing of this kind, and also because you can spot two other troubles at the same time.

"Look here," Gus went on, as he opened the timer and pushed the contacts apart. "These contacts should look smooth and gray as they do now, not rough and pitted. Now, if you place the distributor cap on its side and prop a screw driver so that the shank touches metal and the end comes within a quarter of an inch of the center contact button inside—like this—you can get a line on the condition of the condenser, and the coil, too.

"NOW," Gus continued, after turning on the ignition, "if you break the contacts this way, you should get almost no spark between 'em, and there should be a nice, fat spark between the center button of the distributor and the end of the screw driver. If there is a sizable spark at the contact points as you separate them, and only a thin, weak spark—or none at all—at the end of the screw driver, you can be sure the condenser is just about shot. On the other hand, if there is no spark at the breaker points, and hardly any at the point of the screw driver, the condenser is all right, but you'd better get a new coil."

"And if I still can't find the trouble, then what?" asked Backett.

"Then that's where my phone number comes in!" Gus grinned, as he climbed in behind the wheel of the service car.

ALARM SOUNDS WHERE LIGHTNING MAY STRIKE

SIGNALS which warn that lightning is about to strike at the spot where they are located may be added safeguards to life in the future, according to M. Emile Mathias, eminent French student of lightning phenomena. Such lightning alarms, says Mathias, would need only to detect an unusual concentration of negative electric particles or ions in the air. It has been generally known that lightning strikes where the air is strongly electrified, but this research worker has observed that it is the negative ions which create a most inviting path for the lightning. Practical, automatic indicators, he suggests, could be developed which would mark the danger spots where negative ions were concentrating during a thunderstorm.

SAFETY PEDAL ON CARS TO MEET EMERGENCIES

To DECREASE auto accidents caused by car drivers when they are startled by a sudden emergency, Dr. Yandell Henderson, professor of physiology at Yale, proposes a new safety pedal. Scientists state that a car driver, when suddenly alarmed by an unexpected jolt or the sight of a child running out in front of his car, stiffens and tightens his whole body before meeting the emergency. This instinctive reaction, known as a "self-righting reflex," causes him to press both his feet down hard on the floor. The accelerator pedal is thus pushed and the car spurts ahead until the driver can recover and press his foot on the brake pedal. The proposed safety pedal would be placed on the car floor near the clutch, at the spot where the driver's left foot normally rests. It would be connected with the engine so that the heavy pressure caused by this reflex would either shut off the power or would counteract the effect of the right foot pressing on the accelerator pedal.

NEW SCIENTIFIC WOODCRAFT TRAPS FOREST FIRE FIENDS

(Continued from page 15)

Then, with a pressure spray gun loaded with plaster of Paris and water, he builds up the footprint, layer by layer, until the coating is half an inch thick. He allows the cast to harden for thirty minutes, then removes it for study and for possible use as evidence.

No two men walk exactly alike. Some feet toe in, some toe out, some are always parallel. Tracks may show as much as two inches difference in stride. Lameness or shortness of one leg leaves unmistakable prints. Sometimes, a criminal attempts to disguise his trail by taking long steps or walking backwards but an alert investigator can detect this subterfuge. An individual taking a longer step than his natural gait leaves deeper heel marks. The foot usually makes a slight impression where it first touches the ground and if the footprint proper is not ahead of this mark, the detective suspects a ruse.

FROM the moment a man puts on a new pair of shoes, his habits of walking begin to write their story in the way the shoes wear. Soles and heels wear differently, some nails become more prominent than others, and a distinctive pattern is created. If a track indicates that the person scuffs his heels, the investigator knows he need not look for a man with a good, even heel. If the footprint shows that the suspect drags his toe, the G-man may be sure that the wanted man's shoes will be worn at the tips.

A fire bug who operated in the Trinity National Forest sought to disguise his tracks by wrapping his shoes with burlap. Investigators were nearly baffled but, after following the trail for about three miles over rough country, they found that marks began to show where the hobnails of the shoes were protruding. They took a plaster cast of a good specimen which showed a clear imprint of the hobnail pattern and even the weave of the burlap. Tracking down the suspect, they found him working in the fire-fighters' camp, still wearing the shoes. The hobnails matched the cast perfectly and the evidence sent him to a Federal prison.

Horse tracks are easier to follow. The weight of the animal produces deeper, sharper impressions, revealing not only characteristics due to the blacksmith's individual style of workmanship but also prints of the frog of the foot that are almost as distinctive as fingerprints.

A sleuth investigating an incendiary fire recently found five spots where blazes had been started. Footprints led him half a mile to where a horse had been tied. He then followed hoofprints for eight miles over country so steep that finally the rider had been compelled to dismount and lead his horse.

THE suspect had traveled a circuitous route to throw off pursuers. He failed, however, to shake off the forest sleuth, who trailed him to his home. Here he found a horse whose hoofs exactly matched the tracks and, in the attic, the shoes the fire bug had worn at his work.

Tire prints, too, are cast in plaster. If a suspect's car is found, the tires are rolled in the dust for two feet or more and an impression taken showing not only the tread pattern but every rock cut and bruise as well. Candles, tobacco tins, and other objects often yield fingerprints. Matches are identified by comparison under the microscope with known brands.

For more than a year, mysterious fires flared along the Roosevelt Highway in California, set, apparently, by matches thrown from a car. Examined microscopically, these matches were found to be of a single brand.

Rangers watched the district for months and questioned witnesses for descriptions of persons seen driving through the section near the time of the fires. By careful comparison and elimination, the possible suspects were reduced to four. Tire tracks near the origin of a fire gave them an additional clew. At length, they tracked down each of the four men Three furnished perfect alibis but the fourth could not. In his pockets were found matches identical with those from the fire zones, and more like them in his home. He was a pyromaniac and, upon his imprisonment, the fires stopped.

ONE day a forest G-man received a telegraphic tip that a stranger had just bought a large number of candles at a local store. Jumping into his car, the ranger sped sixty-eight miles to the district. When he arrived, fire already had broken out. He picked up a trail, overtook the man, and demanded to see the candles

"I left them in my tent," he was told. The ranger went along to the camp but the only candles the stranger could produce were two half-inch stubs. The man was held while the ranger, back-tracking, found evidence at the scene of the fire that conclusively established him as the guilty fire bug

A pyromaniac set fire after fire in a western national forest simply for a thrill. When the blaze had started, this man would return to watch the fire fighters as they battled. But swift work by Uncle Sam's forest army usually spoiled the fun. The fire bug then conceived the diabolical scheme of cutting telephone wires, not realizing that a marvelously rapid communication network is one of the Forest Service's first defenses against fire.

As soon as a dispatcher could not get "central," he sent a messenger to locate the trouble. Meanwhile, a lookout atop a near-by mountain spotted the blaze and flashed a warning by short-wave radiophone.

Investigators who hurried to the scene found footprints. They trailed the fire bug to a house where the occupants described a mysterious visitor who had happened along about the time the fire started. From this description, they identified the man among onlookers at the scene of the fire.

A series of six fires in the timber on the slopes of the rugged Sierras of California, brought Forest Service G-men to the scene. Among the ashes they found the remains of several ingenious devices for setting fires, one of which had failed to go off. Laboratory tests showed that eleven minutes were required for it to function, giving the incendiaries plenty of time for their get-away.

SKILLFUL probing among the ashes revealed dim tracks. The sleuths followed a faint trail to a cabin far back in the mountains. Here lived four men whose footprints matched those taken at the scene of the fire. In the cabin were materials which were identical with those used in the apparatus that started the blaze. The men thus linked to the crime were members of a ring of communists who practiced incendiarism as one of their means of sabotage.

One afternoon last spring, Albert L. Leo-Wolf, pilot of a CCC forest-fire patrol plane, noticed a string of fire creeping up the slopes of Wurtsboro Mountain. Near it was a man whom Leo-Wolf carefully sized up. He radioed headquarters, then kept the man in view until he entered a cabin near-by. Flashing this information from his plane, the patrol directed authorities to the spot and caused the arrest of the culprit. This was the first case on record in which a fire bug was tracked from the air.

QUEER THINGS PEOPLE HAVE USED FOR MONEY

(Continued from page 23)

changed hands, then a metal token representing the cloth.

Bean-shaped coins made in Asia Minor were the first minted money in the world. Twenty-six centuries ago, natives of Lydia formed the coins of electrum, a mixture of gold and silver native to the country, and stamped a crude impression on one side. The idea spread to the mainland of Greece and through Greek commerce to all the countries of the Mediterranean. Later, both sides of the coins were stamped and still later mottoes, such as the familiar "In God We Trust"—which first appeared on United States coins about the time of the Civil War—took their places on the metal.

Almost as soon as coins appeared, counterfeiters got busy. Not long ago, archaeologists discovered a hidden cache of Roman coins near an ancient highway in France. All were made of debased metal and were the work of counterfeiters who lived in the days of the Caesars. One curious use of imitation money became widespread in countries where it was

The large coil is a belt covered with tiny humming-bird feathers, from Vanikoro Island. In front of it is tobacco money of Portuguese Africa. The white object is a stone "coin"

customary to bury coins with the dead. Counterfeit money took the place of the actual gold and silver.

Queerest of counterfeit stories, however, is one Gibbs told me about the island of New Guinea. Here, natives used dog teeth as currency. When European traders came to the island, they brought along thousands of porcelain imitation teeth to use as money. The natives, who had become so expert in dealing with canine teeth that they maintained they could tell whether they had been taken from a live or dead dog, were not fooled for long by the ruse.

What is the rarest, most valuable coin? Contrary to common belief, it is far from being the oldest. The coin that brought the highest price in a public auction was a five-dollar gold piece minted in San Francisco in 1849 by the Massachusetts and California Company. A few years ago, it brought $7,900 at an auction in the East.

During the gold-rush days, Gibbs explained, transporting the metal back to the East was a hazardous job, and concerns in California minted much of it into coins. Some of these are at the top of the list of rarities. Other valuable oddities in United States money are the pine-tree shilling, which was issued for thirty years in Colonial New England yet always bore the date 1652; the 1804 half dollar, called "the king of American rarities," and the Confederate half dollar, only four of which were struck. The value of a coin depends upon two things, its rarity and its state of preservation.

Few people know that when the states began issuing paper money, some of them printed the bills in more than one language. In Louisiana, for example, where a large part of the population was French, the money appeared printed in English and French. And in Pennsylvania, it was printed in English and German.

"Mistake money," *(Continued on page 124)*

QUEER THINGS PEOPLE HAVE USED FOR MONEY

(Continued from page 123)

bills that contain some error in printing, are extremely rare, as the money is inspected by experts before it leaves Washington. One famous exception is a one-dollar bill with a two-dollar back, which actually slipped into circulation.

Theoretically, all paper money is based on precious metal held in the treasury of a country. When paper issues are disassociated from a metallic base, inflation is the result. In the Gibbs collection there is a German trillion-mark note. At pre-war exchange rates, it would have been worth more than a million dollars. Actually, in 1923, when it was issued, it was worth less than fifty cents.

Another historic instance of debased currency dates from the time of King Henry VIII of England, Gibbs told me. That ruler's nickname of "Old Copper Nose" came from the fact that he reduced the amount of precious metal in his coins until the outer coating wore away rapidly revealing the copper underneath. As his nose was the highest point on the coin, it turned to copper first.

"TOKENS" and scrip issued by American municipalities during the depression will doubtless be valued highly by future collectors. Some of this was stamped on wood, making the proverbial "wooden nickel" a reality. Another example of depression money is the issuing of tokens worth fractions of a cent, to be used in the payment of sales taxes in various states.

The earliest coin collectors were the Romans. Petrarch, the fourteenth-century Italian poet, sent to all parts of the Mediterranean world for specimens of money. Victor Emmanuel III, the present king of Italy, is famous as a numismatist. His collection of 100,000 coins is the most complete set of Roman and Italian moneys in existence, and his twelve-volume work on the subject is a standard guide throughout the world. Enrico Caruso, the opera singer, was also an ardent coin collector.

Historians estimate that more than 2,000 rulers and places of the ancient past are known to our civilization solely through coins which have outlasted the other works of the time. Like the archaeologist, the coin collector links us with long-ago people and nations. It is mainly through images on coins that we know what Alexander the Great, the Ptolemies of Egypt, Sappho, and Cicero looked like.

Science also turns to numismatics to verify its dates. The year that Halley's comet startled the Romans, for example, has been established through an ancient coin.

Modern collections, such as those of Gibbs, are more than mere assemblages of oddities. Their specimens, coming from the four corners of the earth, embrace thousands of years of history. They form fascinating, human documents, vital to our understanding of the past.

PILLS MAY SUPERSEDE VACCINATION NEEDLE

SWALLOWING a pill may take the place of having a hypodermic needle thrust into the arm, to prevent typhoid, and other infectious diseases. An Illinois doctor recently announced a method to insure the success of "vaccination" via the mouth. Thirty minutes before a vaccine pill is to be swallowed, a pill containing bile extract is taken. In the stomach the bile prevents the secretion of digestive juices that would normally destroy the vaccine. When taken, the vaccine virus is slowly absorbed into the blood through the lower digestive tract without causing soreness, swelling, and other minor discomforts which often occur after vaccine injections into the bloodstream.

CHEMISTRY EQUIPMENT FROM ODDS AND ENDS

(Continued from page 49)

ammonia is used, as many present-day preparations will foam or froth. A Bunsen burner turned very low can be employed. If you have no gas supply at your chemical workbench, an alcohol lamp will do nicely.

In fact, an alcohol lamp is a more useful all-around source of heat in an amateur laboratory than is generally realized. While the ordinary type furnishes insufficient heat for many chemical experiments, this defect is easy to remedy. A tin can, suitably cut to serve as a shield, will prevent the loss of heat to the surrounding air. Remove the top of the can, or cut away the central portion to within half an inch of the outer rim; the latter procedure gives more rigidity. Detach the whole bottom of the can, and cut deep notches in the sides to admit air for combustion. When this fitting is placed over the lamp, the heat is concentrated where it is needed. Several layers of asbestos paper, wrapped around the upper part of the can and cemented over with dilute water-glass solution, will further reduce heat loss. A square of wire screen may be placed upon the top of the can to support a beaker or flask.

WHEN you use an ordinary alcohol lamp, the cork, which carries the wick, often catches fire. This may be prevented by placing a washer or disk of bright tin around the metal tube in which the wick passes through the cork. The shiny metal reflects the heat of the flame and also acts as a cooling fin for the tube. It is easily removed when the glass snuffer, or cap, of the lamp is to be replaced. Denatured alcohol is the best fuel for such a lamp; other kinds are expensive, or, like rubbing alcohol, contain water.

In the list of chemicals available in any home, even safety matches might have been included. Their heads contain potassium chlorate, from which you can liberate chlorine gas in order to observe its interesting properties. The quantity of chlorine gas produced is small, to be sure; but that is just as well, for the gas is so irritating that you would not care to generate a great deal of it indoors.

Place about a teaspoonful of water in a test tube, and drop in the heads of one or two safety matches. Add several drops of muriatic, or hydrochloric, acid, and heat the contents of the tube gently with a small flame. A Bunsen burner turned low, an alcohol lamp, or a candle will do. Have the test tube clamped to a support of some kind, so that your hands will be free. Be sure that the mouth of the test tube is pointing away from you; this is a good rule to follow whenever you are heating a liquid in an open tube, so that if the boiling contents should spatter they will not come your way.

DYE in the match heads may color the solution, but this will not interfere with the reaction that takes place when you heat the test tube. The hydrochloric acid and the potassium chlorate react with each other, releasing chlorine gas. You can readily detect the pungent odor of the chlorine by cautiously smelling the escaping vapor. Don't place your nose to the tube; a better way to detect the odor of any acrid gas, without risking getting too strong a whiff, is to keep the tube a little distance from you and waft the vapor gently toward you with your hand.

Chlorine has a powerful bleaching action on many dyed objects, as you can observe by moistening them and hanging them in the mouth of the test tube. Scraps of colored cloth and paper are turned white, and the dyed red portion of a safety-match box is also bleached; a sliver of it may be bent to a "V" shape and hung on the edge of the tube for this test A drop *(Continued on page 126)*

CHEMISTRY EQUIPMENT FROM ODDS AND ENDS

(Continued from page 125)

of silver nitrate, held in the mouth of the test tube on a glass rod or piece of tubing, turns white; the chlorine, reacting with the silver nitrate, produces a white precipitate of silver chloride. Brightly polished brass or copper is quickly tarnished, and becomes coated with a green chloride of copper if it is exposed to the chlorine vapor for several minutes.

A stock way of of making hydrogen gas is to allow dilute sulphuric or hydrochloric acid to act upon zinc. Sulphuric acid and zinc will not always produce hydrogen, however, as you can easily demonstrate.

MIX two volumes of strong sulphuric acid with one part of water. Be careful to *pour the acid into the water;* if, instead, water is poured into strong sulphuric acid, the heat produced by the lively interaction is apt to turn the first few drops of water to steam and spatter the powerful acid upon anything in the vicinity. Place the acid-water mixture in a flask, add some pieces of zinc metal, and heat the contents of the flask gently.

Moisten a piece of white paper with several drops of lead acetate solution and hold it at the mouth of the flask; it will turn brown or black, indicating the presence of hydrogen sulphide gas. This is the gas produced under the circumstances of the experiment.

Still a different result is obtained if the sulphuric acid is undiluted. In this case, its reaction with the zinc produces sulphur dioxide gas.

These experiments show that what happens when sulphuric acid and zinc react depends upon the strength or dilution of the acid. When hydrogen is the gas desired, the acid should be diluted in the proportion of one part to four or five of water. The same applies when hydrochloric acid is used.

For some of the experiments that you may perform with hydrogen, carbon dioxide, hydrogen sulphide, and other gases, it is desirable that they should be dried — that is, freed of the water vapor that they may contain as a result of ordinary laboratory methods of preparation. This may be done by passing them through a glass tube of half-inch to one-inch diameter, filled with granules of desiccated (anhydrous) calcium chloride, which acts as a dehydrating agent. To construct the drying tube, insert a wad of absorbent cotton, not too tightly packed, at one end of the tubing. Then close this end with a one-hole stopper carrying a glass tube, to which rubber tubing leading from other apparatus may be attached. The anyhydrous calcium chloride may now be poured in from the open end of the drying tube until it is nearly filled. A second wad of cotton is inserted at this end to keep the contents in place, and another one-hole stopper with a glass tube completes the assembly of the essential parts. A useful addition, however, is a pair of square "bumpers" cut from sponge rubber about one inch thick. When holes are cut in the "bumpers" and they are slipped over the tube, one near each end, they protect it from breaking and keep it from rolling about on the top of your chemical workbench.

BEES' SCHEDULE TAKES THEM SOUTH IN WINTER

BEES owned by one of New York State's largest beekeepers have not been loafing through the winter. Deciding that a winter vacation was a useless luxury for the insects, the owner has transported 210 colonies south to feed on Florida wild flowers and orange blossoms. Smaller experiments last year proved satisfactory; 140 colonies sent to winter quarters in Florida thrived and grew to 558 colonies before they were returned to their homes in May.

LIVING RAT TRAPS RAISED ON NOVEL FARMS

(Continued from page 37)

front for two or three weeks before taking them out to the dog territory. Then he transports the box to one edge of the dog town, and arranges a small opening so the ferrets can enter and leave as they please. Once a week he takes water and milk to the box. The ferrets usually are out, but they return to get the food. When all the dog holes in the vicinity are cleaned out, he moves the ferrets to a new location, and in this way gradually works through the dog colony. The ferrets, in spite of their free lives, remain tame, so that he can pick them up wherever he finds them.

IN SOME sections, including parts of the State of Washington, ground squirrels are destructive pests. Ferrets have proved effective aids to farmers in cleaning them out. The ferrets are trained to enter the squirrels' holes and either kill them or chase them out where dogs can do the job. One man, with three ferrets and two dogs, destroyed sixty-two squirrels in less than two hours. A half-dozen ferrets will rid a farm of its squirrel population, and keep it that way.

Not long ago, the ferret joined the medical profession in its fight against influenza. Farnsworth has sold animals for laboratory use in connection with the production of influenza serum. In England, it has been reported that the ferret apparently is the only animal that can be used for producing serum that is effective when administered to humans to combat influenza.

Farnsworth's ferret farm looks, to the visitor who turns into it from the gravel road, not unlike any other farm. A closer inspection reveals that there are several outbuildings not exactly like the usual farm structures. They are long and narrow, and have peculiar openings along the sides. These are the ferret houses. There are, in all, six of these long structures, each containing from seventy-five to 132 pens. They are twelve feet wide, and some of them are over 100 feet long. Inside, there is a three-foot alleyway running the length of each building. It is flanked by the ferret stalls or pens, each measuring two by four and one half feet, and thirty inches high. In front of each pen is wire netting, which aids ventilation and permits the animals to get exercise by running over it, like squirrels. Extending from one end of the building to the other on each side are two ventilating doors, one at the top and the other at the bottom. These are covered with netting, the top ones with mesh small enough to keep sparrows out.

Floors of the stalls are solid, with the exception of about eighteen inches at the rear, which is slatted to permit moisture to escape. The pens must be kept dry, in order to prevent disease. Farnsworth uses wheat straw for bedding his animals, changing it whenever it becomes dirty.

ANYONE who wants to keep a few ferrets can house them in a store box measuring about three by four feet, and thirty inches high, Farnsworth says.

Young ferrets will thrive on a diet consisting principally of bread and unskimmed milk and meat. After reaching maturity in the fall, the animals can be kept on a diet of meat and water, although milk is desirable when it is available.

Farnsworth has to use large-scale methods for feeding his big colony of ferrets. He raises cattle so that there will be a steady supply of fresh milk; and wheat which produces material for graham mush, and straw for bedding. Although meat is excellent food, it is not fed extensively because it is too costly. He cooks the graham *(Continued on page 128)*

LIVING RAT TRAPS RAISED ON NOVEL FARMS

(Continued from page 127)

mush in a large kettle holding seventy-five gallons. Two batches a day are prepared, for the animals are fed morning and night. The mush is ladled out into buckets and allowed to cool.

For transporting this food to the various pen houses, Farnsworth uses an overhead-trolley system. The car is equipped with a geared winch by which the platform supporting the buckets of mush can be raised and lowered. The car is pushed along from house to house, and from pen to pen. When the pens are being cleaned, the food car is uncoupled and replaced with a wooden box for carrying out soiled straw.

WITH this system, one man, working full time, can care for about 1,000 ferrets. The cost of raising a ferret to marketable size is about a dollar a year. The retail price varies with the season. Ferrets are cheapest in the fall, when the money spent on feeding the young animals has not reached a very high total. As the season advances, and the upkeep cost piles up, the prices rise. At present, prices range from two dollars to three dollars and higher for single animals.

The breeding season for ferrets runs from about March 1 to September 1. There are, on the average, eight or nine young to a litter, although the number may reach fifteen. These are guarded very carefully by the jealous mother, who will pounce on anything that threatens to disturb them. A simple nest is made by placing straw in a box measuring twelve by fourteen inches, and about nine inches high. A depression is made in the straw for the mother ferret. She lines this with hair shed from her body.

Born with their eyes closed, the young ferrets cannot see until they are six weeks old The ferret raiser, by weaning the babies as soon as possible, frequently can secure a second litter the same season. The weaning process consists of feeding the young animals bread soaked in milk, with perhaps some finely chopped meat, as soon as they will eat it. By the time their eyes are open, they will come to the dish for their meals, and can be separated permanently from their mother.

Farnsworth begins handling and training his ferrets as soon as their eyes are open. Thus, by the time they are ready for market, they are tame, and expert at catching rats and other animals. A ferret will hunt instinctively as soon as it reaches the proper age. Farnsworth has found that a ferret, when tame, makes as gentle a pet as a kitten.

From a commercial standpoint, the ferret's chief value is as an exterminator of rats and other pests, a business at which it is particularly effective. Its pelt has no value worth mentioning; its meat is not popular as food.

SOME people ask Farnsworth whether the use of ferrets for clearing a region of some pest might not act like a boomerang by introducing an even greater pest. He explains that the ferret, if released and left to shift for itself, does not survive very long. Dogs and other enemies soon destroy it, so that it cannot multiply. Therefore, there is little danger that escaped ferrets will overrun a region. Properly raised ferrets are so tame that, after they have completed a particular assignment of killing rats or other vermin, they can be picked up with ease. It generally is not a good idea to pull them forcibly from a hole, because this frightens them. They should be permitted to travel a few feet from the hole before being picked up.

In some states, where hunting rabbits with ferrets is prohibited, permits are necessary for purchasing the animals or shipping them into the state.

HERE'S THE ANSWER

(Continued from page 55)

same as the difference in sounds produced by the long, heavy wires of a piano and those made by the short, lighter wires. The quality or timbre of a voice is due to the size and shape of the larynx or voice box.

At Least, He'll See the Bait

A. F. T., LITTLE ROCK, ARK. Fishing upstream is likely to be more effective because fish lie in the stream with their heads turned towards the current.

For a Non-Skid Rug

I. G. B., ATLANTIC CITY, N. J. Rugs can be made slip-proof, with little expense, by sewing a triangle of corrugated rubber (corrugations on the down side) under each of the corners.

A Lot of Alligator

Q.—HOW large are the biggest specimens of alligators?—M. C., Pueblo, Colo.

A.—AN OBSERVER, who has studied the alligator in its native haunts for most of his lifetime, records the largest alligator he has measured as being nineteen feet two inches long. The females, according to records, seldom exceed nine feet in length.

A Nutty Seed

S. A. T., SIOUX CITY, IOWA. The cashew nut is not, correctly speaking, a nut but the seed of a small, crescent-shaped fruit which grows on an evergreen tropical tree. On the tree, this small fruit, the kernel of which is the familiar cashew nut, appears to be attached to the bottom of a large pear-shaped fruit. The latter is actually the fruit stem which is many times larger than the fruit it supports.

Being Higher, It's Lower

G. I. S., HAMTRAMCK, MICH. It takes longer to cook foods by boiling at a high altitude because water boils at a lower temperature than at sea level. For example, water would boil on the top of Mt. Blanc at about 183 degrees F. whereas at sea level it boils at approximately 212 degrees F. Lower atmospheric pressure brings a lowered boiling point so that at a high altitude it is not possible to produce enough heat by boiling to do a good cooking job.

Taste-Robbing Colds

S. D., NEW BRITAIN, CONN. Food does not taste right when you have a cold because of the partial stoppage of the nasal passages. The nerve endings which are stimulated by odors cover a very limited area of the upper nasal cavities. Taste and smell are commonly confused. The so-called taste of many foods, such as fruits, coffee, and wine, are really aromas which we smell but associate with the sense of taste.

Red to Green to Black

Q.—WHY does a green leaf appear black under a red light?—I. T. D., Lincoln, Nebr.

A.—OBJECTS do not have a fixed color of their own but depend for color upon the light waves which they reflect from their surface. Surfaces which reflect all color rays appear white in sunlight (where all color waves are present), red in red light, blue in blue light, and so on. Surfaces which absorb all light waves and reflect none appear black under any light. A green leaf reflects the green rays but absorbs all the others. Under the red light, there are no green rays, consequently the red rays are absorbed and the leaf appears black.

HOW DANGEROUS IS YOUR JOB?

(Continued from page 35)

for a long period and the insurance company paid him the full limit of his policy, which in this case was twice as much as would have been paid if he had been killed, and four times as much as if he had lost his entire hand!

A carpenter doing general work or framing on buildings, as that man did before his accident, faces about as much danger as a tree pruner, an etcher using acid, or a pneumatic-drill operator in a quarry when no explosives are used. All are in the fifth class.

But a carpenter doing bench work only, with no scaffolds to fall from, and no risk of tools or materials dropping from above, is as safe as a dentist or a lens grinder, in the third group.

If, however, the carpenter uses power-driven machinery, his hazard leaps about two thirds higher! He is in the sixth class, with roofers, building movers, cutlery grinders using unguarded wheels, hostlers, display-sign electricians, street-lamp testers, and noodle-machine operators.

HUNDREDS of strikingly different jobs share the same degree of danger when their accidents, from minor hurts to deaths, are reduced to a dollars-and-cents basis. Fifteen days' work were lost by an iceman who fell down a stairway and stabbed his arm with a pick. A truck driver strained his back while handling a heavy crate. A live-stock tender was trampled by steers. A threshing-machine feeder was caught in the machine and killed. From the insurance company's viewpoint, these accidents fell in the same class.

All those jobs are "safe" however, in comparison with those in the next group. The menace of death creates an ominous distinction between the sixth and seventh classes.

During the construction of a building, a few years ago, two men were killed. One was a truckman, hauling steel, crushed when a beam slipped from its sling. The other was a riveter; he fell ten stories. It happened that both men carried accident insurance. The cost to both had been practically the same. But when they were killed, the truckman's policy paid $1,000, and the riveter's paid only $200!

That was the company's limit on death claims of riveters and other workers in the seventh class or higher—$200. It represents a sinister calculation of their chances of death and the company prefers to avoid that additional risk!

If a riveter is hurt, and lives, he is paid the same as a truckman or a cutlery grinder would be paid for the same degree of disability. In other words, the riveter's danger of injury, *not counting death,* is as great as the truckman's danger of injury *or* death.

In his own peculiar way, a trapeze performer takes about the same chances as a riveter. Others who go just as far to meet danger, are steam-shovel laborers, comb benders and jig-saw operators, sailing-vessel captains, and locomotive engineers.

THE hot-blast tender in a Bessemer steel mill is a step closer to peril; and a freight brakeman is still closer. The latter runs nearly twice as much chance of injury as his engineer! Death isn't very important in these comparisons because it means a much smaller payment than serious disability.

Among the ninth-class men, working in as much danger as brakemen, are well drillers and quarrymen who use explosives, operators of corn-husking-and-shredding machines, lumber-camp river drivers who guide floods of logs downstream, cartridge makers, fireworks handlers, sponge fishers, and seamen on sailing vessels.

A man in any of these occupations is seven or eight times as likely to be injured or killed as a bookkeeper.

As great as the difference is, it would be far greater, except for the fact that automobile accidents and accidents at home cause more injuries and deaths than accidents at work. The office clerk is just as likely as a quarryman to be the victim of a car, or a fall in the bath tub. It is the additional danger of the quarryman's work which makes his hazard more than seven times as great.

The auto toll has become so serious, however, that many companies now are considering a new system of classifications, with only four groups of occupations. They think the traffic Juggernaut is crushing out all minor differences of hazard to human life.

Distinct from the perils that follow a man through the twenty-four hours of the day, the dangers that exist while he is at work probably are watched more closely by compensation-insurance companies than by any others. In the last ten years, they have spent more than a billion dollars in settlement of claims against employers by injured workmen—as well as by the relatives of workmen who were killed.

LIKE the accident-insurance companies, they regard clerical office work as the safest occupation. Unlike the accident companies, however, they cannot exclude death from their calculations, even in the most dangerous industries. And in case of serious accident, they may have to pay many times as much as the amount of the ordinary accident policy. Figured on this basis, a comparison of jobs discloses many with terrific hazards.

In New York, a structural-steel worker's danger is just 506 times as great as a stenographer's.

Cleaning the outside of an old building is ten percent more hazardous than putting up steel for a new one.

Accidental injury or death is 339 times as likely on a compressed-air caisson job as in an office.

Air-transport pilots and all flying employes on scheduled routes are in 175 times as much danger as the "safest" workers.

Stevedores run sixty-three times the risk of clerical workers while they load or unload ships by hand and hand truck; and 155 times as much if power hoisting machinery is being used!

These are the average dangers in the industries. On individual jobs, there may be wide variations. When a large employer buys compensation insurance, an inspection engineer decides whether he is likely to have fewer or more accidents than the average for his business. Studies are made of his accident record during the preceding five years, the skill of the men he employs, the presence of safety devices—and the special efforts for accident prevention.

IN ANY job, the insurance company knows that the danger really depends on two things. One is the inherent hazard of the work, the opportunity for an accident. Working on a window ledge or a scaffold thirty stories above the ground, or shoving a plank against the teeth of a circular saw which doesn't know the difference between wood and flesh, creates more possibilities for accident than guiding a fountain pen over smooth bond paper. But a part of the peril—often a very large part—is within control of the individual.

The science with which insurance companies calculate the risk of an occupation does not reveal any method of abolishing accidents altogether. But it shows where they are most likely to occur. And it suggests that if one man, because of his job, has to take twice or three hundred times as many chances of injury or death as another man, he will do well to be at least three hundred times as careful!

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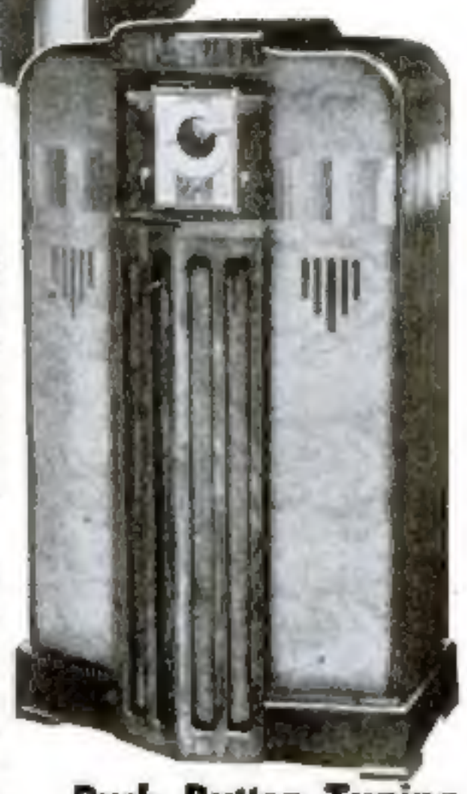

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A HALF CENTURY OF ALUMINUM

(Continued from page 28)

in determining the proportions of different metals in them. In one alloy, for example, a minute amount of cadmium is present. Measuring it by ordinary metallurgical methods is slow and difficult. By the new method, the scientist merely examines the alloy with the spectroscope and determines what metals are present by the position and intensity of the lines in the spectrum.

One of the latest aluminum products which has resulted from research is a brilliant reflector. This reflector is now in use with sodium lamps on eastern highways. Experiments show it has almost as high reflectivity as silver and, at the same time, does not tarnish.

TWO years ago, a report of the U. S. Bureau of Standards gave dramatic evidence of aluminum's resistance to corrosion. The Government scientists examined the cap on the 555-foot Washington Monument. For nearly five decades, the little pyramid had withstood constant weathering. Yet they found its surfaces still able to reflect sunlight.

Incidentally, the vast progress made in aluminum fabrication in fifty years is exemplified by comparing the 100-ounce cap of the monument, the largest aluminum casting in the world at the time it was made, and a 7,500-pound Diesel motor part cast recently.

Additional resistance to corrosion is being given aluminum by an ingenious electrochemical process known as the anodic treatment. A very thin layer of oxide ordinarily protects the metal from weathering. By using the aluminum as the anode, or positive electrode, in the treatment, a heavy layer of oxide is added to its surface. By dyeing the oxide surface, aluminum in brilliant colors is now being produced and placed upon the market.

A recent test proved that thin layers of aluminum foil would make an efficient heat insulator. Thirty pounds of foil, it was discovered, would insulate a truck body as effectively as 2,000 pounds of cork.

Most metals are as old as history. Lead was used by the ancient Romans. Iron and copper go back to 3,000 years before the birth of Christ. But aluminum, in contrast, is a modern metal of the laboratory.

Scientifically, it dates back only to 1825; commercially, to the 1880's. Millions now living have witnessed virtually the whole of its dramatic rise. In five short decades, in the years since Charles Martin Hall came to the end of his quest in his back-yard laboratory in Oberlin, the aluminum age has become a reality.

NEGATIVE IONS AFFECT OUR HEALTH AND MOODS

MYSTERIOUS electric particles in the air affect human happiness and health, according to a theory being investigated by Dr. Harlan T. Stetson of Harvard University, one of the scientists studying the effect of ionized air on human welfare. The theory is that ductless glands, believed to control our temperament and well-being, are stimulated when air is ionized, or charged with negative particles of electricity. In an experiment recently performed in a room where negative charges had been removed from the air, a subject developed a headache and became depressed and tired. Shortly after the air had been ionized, he lost his headache and appeared to return to his normal spirits. Dr. Stetson is now trying to discover whether sun spots cause the ionization of the earth's atmosphere. If so, science may be able to prove that radiations from the sun influence human affairs as well as climate and the growth of crops.

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